

BENTON HARBOR POWER PLANT LIMNOLOGICAL STUDIES
PART IX. THE BIOLOGICAL SURVEY OF 10 JULY 1970

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INTRODUCTION

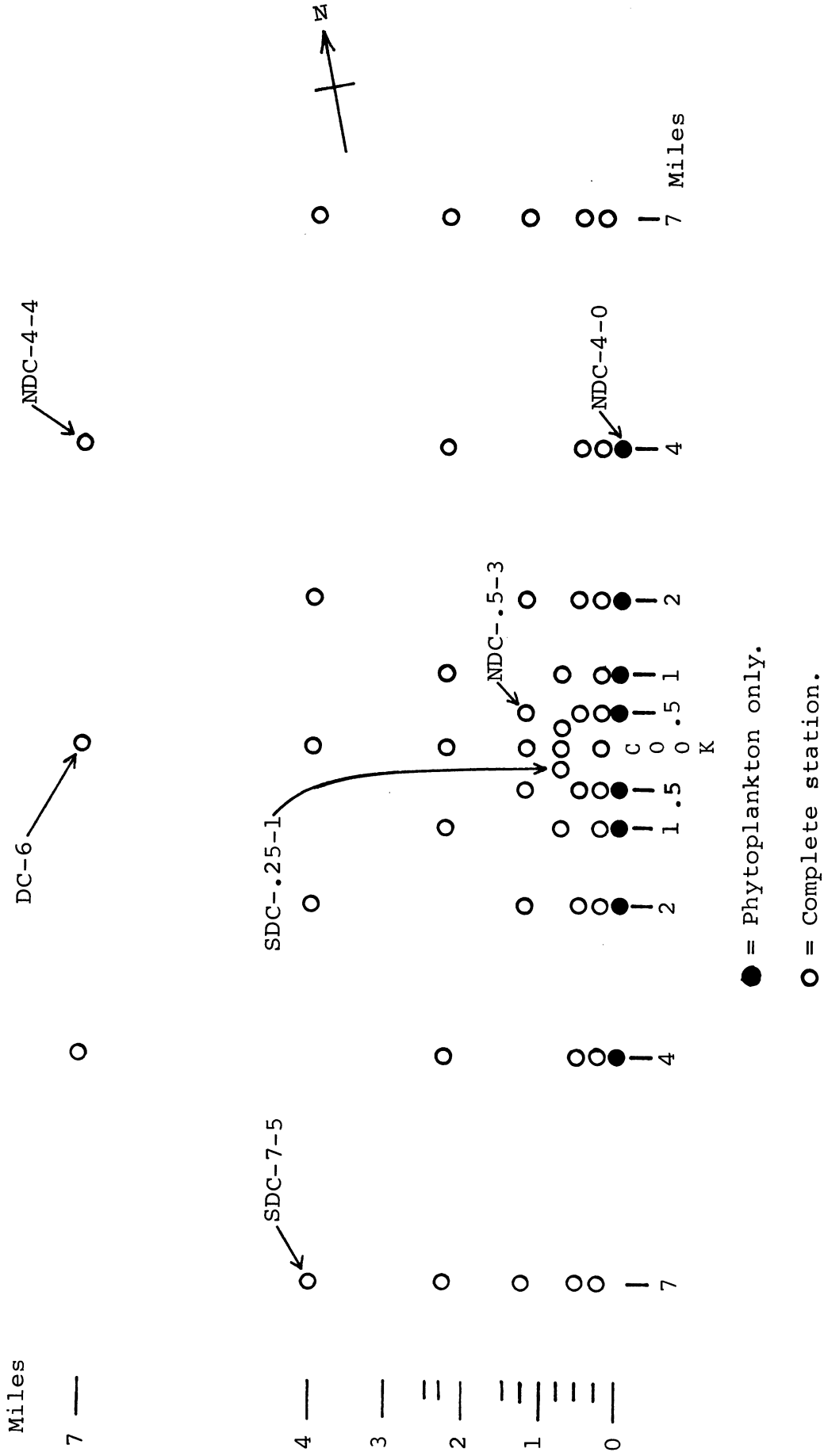
In Part VII (March 1971) of our report series relative to the Donald C. Cook Nuclear Station, we established the following report format:

- A. COOK PLANT PREOPERATIONAL STUDIES
 - A.1 Recording of Local Water Temperatures
 - A.2 Study of Floating Algae and Bacteria
 - A.3 Development of a Monitor for Phytoplankton
 - A.4 Study of Attached Algae
 - A.5 Study of Zooplankton
 - A.6 Study of Aquatic Macrophytes
 - A.7 Study of Benthic Organisms
 - A.8 Study of the Local Fishes
 - A.9 Support of Aerial Scanning
- B. SURVEYS OF EXISTING WARM WATER PLUMES
- C. THE ICE BARRIER AT THE COOK PLANT SITE
- D. EFFECTS OF EXISTING THERMAL DISCHARGES ON LOCAL ICE BARRIERS
- E. EFFECTS OF RADIOACTIVE WASTES IN THE AQUATIC ENVIRONMENT
 - E.1 Gamma Scan of Bottom Sediments
 - E.2 The Most Sensitive Organism for Concentration of Radwastes
 - E.3 Study of Lake Michigan's Present Radioactivity Content
(FINISHED)

This report covers only items A.2, A.5, and A.7 of the above format. These studies constitute our initial survey of the large-scale set of biology stations related to the Donald C. Cook Plant and were carried out on 10 July 1970.

The layout of sampling stations, with indication of how the stations are numbered is given in Figure 1. The sampling stations, their positions relative to the Cook Plant, their distances offshore, and the water depths encountered are given in Table 1.

FIGURE 1. The Cook Plant Sampling Stations.



The stations are designated as follows: SDC stations are located south of the Donald Cook Plant, NDC stations are north of the plant, and the DC stations are directly offshore. The first number in the designation is the number of miles north or south of the plant. The second number is the serial number of the station. The serial number of the phytoplankton-only stations is 0.

TABLE 1. The Sampling Stations, Their Positions Relative to the Cook Plant, Their Distances Offshore, and the Water Depths Encountered on 10 July 1970.

Station	Position Relative to the Cook Plant								Water Depth (ft)
DC-1	Directly off the plant, 1/4 mi offshore								19
DC-2	"	"	"	"	3/4	"	"		40.5
DC-3	"	"	"	"	1 1/4	"	"		56.5
DC-4	"	"	"	"	2 1/4	"	"		65.5
DC-5	"	"	"	"	4	"	"		79.5
DC-6	"	"	"	"	7	"	"		130.5
NDC-.25-1	1/4 mi north of the plant, 3/4 mi offshore								38
NDC-.5-1	1/2	"	"	"	"	1/4	"	"	20.5
NDC-.5-2	"	"	"	"	"	1/2	"	"	26.5
NDC-.5-3	"	"	"	"	"	1 1/4	"	"	56.5
NDC-1-1	1	"	"	"	"	1/4	"	"	18.5
NDC-1-2	"	"	"	"	"	3/4	"	"	33.5
NDC-1-3	"	"	"	"	"	2 1/4	"	"	57.5
NDC-2-1	2	"	"	"	"	1/4	"	"	18.5
NDC-2-2	"	"	"	"	"	1/2	"	"	21.5
NDC-2-3	"	"	"	"	"	1 1/4	"	"	51
NDC-2-4	"	"	"	"	"	4	"	"	74.5
NDC-4-1	4	"	"	"	"	1/4	"	"	17.5
NDC-4-2	"	"	"	"	"	1/2	"	"	29
NDC-4-3	"	"	"	"	"	2 1/4	"	"	55.5
NDC-4-4	"	"	"	"	"	7	"	"	134.5
NDC-7-1	7	"	"	"	"	1/4	"	"	22
NDC-7-2	"	"	"	"	"	1/2	"	"	27.5

TABLE 1 continued

Station	Position Relative to the Cook Plant								Water Depth (ft)
NDC-7-3	7	mi north of plant, 1 1/4 mi offshore							48
NDC-7-4	"	"	"	"	"	2 1/4	"	"	52.5
NDC-7-5	"	"	"	"	"	4	"	"	71.5
SDC-.25-1	1/4	"	south	"	"	3/4	"	"	49.5
SDC-.5-1	1/2	"	"	"	"	1/4	"	"	19.5
SDC-.5-2	"	"	"	"	"	1/2	"	"	28.5
SDC-.5-3	"	"	"	"	"	1 1/4	"	"	54.5
SDC-1-1	1	"	"	"	"	1/4	"	"	13.5
SDC-1-2	"	"	"	"	"	3/4	"	"	40
SDC-1-3	"	"	"	"	"	2 1/4	"	"	61.5
SDC-2-1	2	"	"	"	"	1/4	"	"	18
SDC-2-2	"	"	"	"	"	1/2	"	"	27.5
SDC-2-3	"	"	"	"	"	1 1/4	"	"	51.5
SDC-2-4	"	"	"	"	"	4	"	"	72.5
SDC-4-1	4	"	"	"	"	1/4	"	"	14
SDC-4-2	"	"	"	"	"	1/2	"	"	37.5
SDC-4-3	"	"	"	"	"	2 1/4	"	"	59.5
SDC-4-4	"	"	"	"	"	7	"	"	102.5
SDC-7-1	7	"	"	"	"	1/4	"	"	14
SDC-7-2	"	"	"	"	"	1/2	"	"	26.5
SDC-7-3	"	"	"	"	"	1 1/4	"	"	51.5
SDC-7-4	"	"	"	"	"	2 1/4	"	"	53.5
SDC-7-5	"	"	"	"	"	4	"	"	70.5

Phytoplankton samples were taken at all the stations of Table 1. At all stations with serial numbers greater than zero, zooplankton, benthos, and physical measurements were collected as well. Total collections were: 53 phytoplankton samples and 46 each of zooplankton, benthos, and the physical measurements. The physical measurements consisted of surface water temperature, water depth, bottom types, Secchi disc water transparency, and water color as seen above the white 30-cm Secchi disc. Weather conditions and wind and wave characteristics were taken and meteorological data taken on 10 July 1970 apply to all the sections of this report; these data are presented in Appendix A.

A. COOK PLANT PREOPERATIONAL STUDIES

A.2 Study of Floating Algae and Bacteria

Techniques for bacteria had not been mastered at the time of this survey.

Phytoplankton Techniques

Phytoplankton samples were collected by Nansen bottle at a depth of 1 m, with the exception of the nearshore stations. Nearshore collection (serial number zero stations) were made by submerging an open 1-liter bottle 4 in. below the water surface. All samples were 1-liter whole samples. Each sample was fixed with Utermohl's iodine fixative immediately after collection and stored in an opaque container.

In the laboratory, each sample was concentrated to 100 ml by settling in a 1000-ml graduate cylinder and siphoning off 900 ml of fluid. The concentrated sample was stored in a 100-ml opaque bottle.

Samples were prepared for counting by placing an aliquot of the concentrated sample in a tubular combination settling and counting chamber and allowing the aliquot to settle overnight. The counting chamber containing the settled cells was then separated from the settling chamber, covered, and placed on the microscope. The samples were counted on an inverted binocular microscope at 1000x magnification.

Solitary species, green and blue-green algae colonies, and the filaments of filamentous forms were each counted as one cell. Each colonial diatom cell was counted except when the size of the filaments or colonies prohibited counting the individual cells; in this case, the number of individual cells was estimated.

Phytoplankton Summary

The phytoplankton summary which follows (Table 2) is based on the one used by the Michigan Water Resources Commission in reporting their phytoplankton collections. Our summaries differ only in that we have counted or estimated the cells in filamentous and colonial diatoms, while the Commission counts a filament or colony as a single organism. The station-by-station phytoplankton records constitute Appendix B.

Dominant and Codominant Phytoplankters

In each phytoplankton sample, one species or group typically was present in substantially greater numbers. We have called these species or groups "dominant." In six of the stations, however, a second species or group challenged the numerical superiority of the dominant species. When the challenging species or group closely approached the cell numbers of the dominant species, the second most abundant species or group was recorded as a "codominant," and both are listed in the dominant species column of Table 2. In Table 3, those species or groups which were numerically dominant in the samples of the 10 July 1970 Cook Plant survey are presented.

In the 53 phytoplankton samples of the survey, there were 59 dominant or codominant species or groups, of which 49 were diatoms. On the basis of the dominants and codominants of this survey, Lake Michigan in the region of the Donald C. Cook Plant was definitely a "diatom lake" in early July 1970.

TABLE 2. Phytoplankton Summary, 10 July 1970. Units: Cells Per Milliliter; Surface Temperature, C°; ND = Not Determined.

Station	Temperature	Coccolid Blue-Green	Filamentous Blue-Green	Coccolid Green	Filamentous Green	Flagellates	Centric Diatoms	Pennate Diatoms	Desmids	Other Algae	Total Algae	Dominant Species
DC-1	20.9	0	39	39	7	108	20	167	4	0	384	<u>Tabellaria fenestrata</u>
DC-2	20.9	0	36	85	4	116	8	120	6	0	375	<u>Fragilaria crotonensis</u>
DC-3	20.9	0	64	124	6	154	8	288	4	1	648	<u>Tabellaria fenestrata</u>
DC-4	20.7	0	9	278	0	14	4	110	0	0	415	Unidentified green
DC-5	20.2	0	38	23	0	69	2	128	5	0	265	<u>Fragilaria crotonensis</u> & <u>Tabellaria fenestrata</u>
DC-6	19.6	0	4	36	0	81	0	185	1	0	307	<u>Fragilaria crotonensis</u>
NDC-.25-1	21.3	0	36	36	1	163	12	206	4	0	458	<u>Tabellaria fenestrata</u>
NDC-.5-0	ND	0	52	315	4	608	482	352	7	0	1,820	<u>Melosira</u> sp.
NDC-.5-1	19.7	0	24	32	2	102	101	239	3	0	503	<u>Tabellaria fenestrata</u>
NDC-.5-2	20.5	0	56	81	0	192	13	307	1	0	650	<u>Tabellaria fenestrata</u>
NDC-.5-3	20.8	0	55	90	2	148	5	224	4	0	524	<u>Tabellaria fenestrata</u>
NDC-1-0	ND	11	60	263	0	193	1,287	575	4	404	2,797	<u>Cyclotella</u> sp.
NDC-1-1	19.9	0	26	115	0	204	441	334	11	26	1,157	<u>Cyclotella</u> sp.
NDC-1-2	20.5	689	17	22	0	66	5	173	0	0	972	Unidentified blue-green
NDC-1-3	20.2	0	124	70	4	161	2	172	8	0	541	<u>Tabellaria fenestrata</u>
NDC-2-0	ND	15	33	223	7	212	386	219	15	0	1,110	<u>Melosira granulata</u>
NDC-2-1	19.8	0	32	53	2	203	212	418	5	0	925	<u>Tabellaria fenestrata</u>
NDC-2-2	20.4	0	22	48	0	189	52	148	7	0	467	<u>Tabellaria fenestrata</u>
NDC-2-3	20.4	0	32	171	4	178	7	208	0	0	600	<u>Tabellaria fenestrata</u>
NDC-2-4	19.3	2	9	76	2	130	4	289	4	0	516	<u>Tabellaria fenestrata</u> & <u>Fragilaria crotonensis</u>
NDC-4-0	ND	0	26	675	0	174	582	330	0	52	1,542	<u>Melosira</u> sp.
NDC-4-1	19.9	2	30	564	2	186	1,414	614	0	0	2,812	<u>Melosira granulata</u>
NDC-4-2	19.9	15	18	128	0	210	729	393	2	0	1,495	<u>Melosira granulata</u> v. <u>angustissima</u>
NDC-4-3	19.9	0	28	22	3	67	1	154	0	0	275	<u>Tabellaria fenestrata</u>
NDC-4-4	19.6	0	14	16	1	72	2	108	8	0	331	<u>Dinobryon divergens</u>
NDC-7-1	20.8	4	5	514	3	230	830	229	6	0	1,821	<u>Tabellaria fenestrata</u>
NDC-7-2	20.6	0	25	10,278	1	261	676	322	7	0	11,570	Unidentified green
NDC-7-3	20.2	0	26	89	0	212	382	369	10	0	1,115	<u>Cyclotella</u> sp.

TABLE 2 continued

Station	Temperature	Coccolid Blue-Green	Filamentous Blue-Green	Coccolid Green	Filamentous Green	Flagellates	Centric Diatoms	Pennate Diatoms	Desmids	Other Algae	Total Algae	Dominant Species
NDC-7-4	20.6	0	30	742	0	122	0	367	0	0	1,261	<u>Tabellaria fenestrata</u>
NDC-7-5	19.6	0	14	16	1	72	2	111	2	0	218	<u>Tabellaria fenestrata</u>
SDC-.25-1	20.8	1	5	3	1	29	0	94	0	0	132	<u>Tabellaria fenestrata</u>
SDC-.5-0	ND	6	30	145	6	67	377	406	4	0	1,040	<u>Cyclotella</u> sp.
SDC-.5-1	19.9	158	21	55	1	97	121	260	4	0	717	<u>Tabellaria fenestrata</u> ; <u>Aphanothece</u> sp.
SDC-.5-2	20.8	0	26	32	1	81	38	113	258	0	542	<u>Tabellaria fenestrata</u>
SDC-.5-3	.....	.....	.....	.....	.....	missing	.....	.....	.....	.....	.....	.....
SDC-1-0	ND	0	33	119	0	237	564	382	7	0	1,342	<u>Tabellaria fenestrata</u> ; <u>Melosira</u> sp.
SDC-1-1	19.8	0	41	35	4	143	191	360	0	0	774	<u>Tabellaria fenestrata</u> ; <u>Cyclotella</u> sp.
SDC-1-2	21.0	0	21	16	10	590	3	93	1	0	734	<u>Hypnodinium</u> sp.
SDC-1-3	20.8	0	24	37	4	46	11	263	0	0	385	<u>Tabellaria fenestrata</u>
SDC-2-0	ND	0	17	41	4	139	401	360	0	0	962	<u>Cyclotella</u> sp.
SDC-2-1	20.0	178	24	79	9	102	241	367	6	0	1,006	<u>Cyclotella</u> sp.; <u>Microcystis aeruginosa</u>
SDC-2-2	21.2	0	11	22	2	75	2	130	3	0	245	<u>Tabellaria fenestrata</u>
SDC-2-3	20.9	0	35	23	0	50	6	190	3	0	307	<u>Tabellaria fenestrata</u>
SDC-2-4	19.0	0	5	7	0	72	1	206	1	0	292	<u>Tabellaria fenestrata</u>
SDC-4-0	ND	2	52	131	0	180	261	480	6	0	1,112	<u>Tabellaria fenestrata</u>
SDC-4-1	20.2	0	32	32	2	83	60	267	3	0	479	<u>Tabellaria fenestrata</u>
SDC-4-2	21.0	0	56	236	3	101	20	324	2	0	742	Unidentified green
SDC-4-3	20.8	0	68	20	1	80	26	211	1	0	407	<u>Tabellaria fenestrata</u>
SDC-4-4	19.6	0	9	11	1	82	2	193	1	0	299	<u>Tabellaria fenestrata</u>
SDC-7-1	21.5	0	73	56	5	142	62	236	1	0	575	<u>Tabellaria fenestrata</u>
SDC-7-2	21.4	1	93	12,692	4	138	82	337	2	0	13,349	Unidentified green
SDC-7-3	21.0	0	86	58	3	141	32	304	4	0	628	<u>Tabellaria fenestrata</u>
SDC-7-4	20.8	0	105	112	0	259	30	219	4	0	729	<u>Chamydomonas</u> sp.
SDC-7-5	19.8	0	14	68	0	119	22	219	1	0	443	<u>Tabellaria fenestrata</u>

TABLE 3. Dominants and Codominants in the Samples of the Survey

Species or Group	Dominant or Codominant Occurrences
<u>Tabellaria fenestrata</u> (diatom)	32
<u>Cyclotella</u> sp. (diatom)	7
<u>Melosira</u> spp. (diatoms)	6
<u>Fragilaria crotonensis</u> (diatom)	4
Unidentified green algae	4
Unidentified blue-green algae	1
<u>Dinobryon divergens</u> (flagellate)	1
<u>Aphanothece</u> sp. (blue-green)	1
<u>Hypnodinium</u> (?) sp. (dinoflagellate)	1
<u>Microcystis aeruginosa</u> (blue-green)	1
<u>Chlamydomonas</u> sp. (flagellate)	1
TOTAL	59

Spatial Distribution of Dominants and Codominants

Little can safely be said about spatial distribution of phytoplankters, for they can be exchanged from water mass to water mass by turbulent mixing. The problem is compounded by the annual, seasonal, preoperational, and post-operational differences which may be encountered in a continuing series of surveys, such as required for the Cook Plant.

Although we are, at present, only beginning to be accustomed to having massive phytoplankton data with which to work, we have noted some characteristics of the spatial distribution of dominant and codominant phytoplankton species which appear to be worthy of record.

In this survey, the dominant organisms in the surf-zone stations (serial number zero) were the diatom groups Melosira sp. and Cyclotella sp. In the rest of the area, the diatom Tabellaria fenestrata was the most frequent dominant. In stations farthest offshore, the diatom Fragilaria crotonensis was more apt to be dominant than in the inshore stations.

The Master List of Phytoplankters Collected During the Survey

Another of the requirements in a long-term series of surveys aimed at detecting changes in phytoplankton populations over a period of time is the routine presentation of lists of all the phytoplankters collected during each survey. Over a period of years, such "master lists" become the means of detecting the arrival of new species or the vanishing of species originally present. We do not expect the latter to happen; our present knowledge of the Lake Michigan phytoplankton indicates that species are not eliminated from the phytoplankton population, but rather that new species appear and are added to the population.

The master list of phytoplankters collected during the survey of 10 July 1970 is presented in Table 4. In this table there are incomplete identifications and unidentified organisms, generally occurring in the green or blue-green groups. We make no apologies for this. Our primary attention is directed to the diatom groups where population composition change is apt to show soonest. Our collections are preserved, and may be re-studied if other organisms or groups exhibit changes which indicate the desirability of re-study. For convenience in inspection of names, the contents of Table 4 are arranged alphabetically.

TABLE 4. Master List of Phytoplankton Collected on 10 July 1970.

<u>Achananthes hauckiana</u>	<u>Coelastrum</u> sp.
<u>Achnanthes</u> sp.	<u>Coelastrum sphaericum</u>
<u>Amphipleura pellucida</u>	<u>Coelosphaerium</u> sp.
<u>Amphiprora ornata</u>	<u>Cosmarium</u> sp.
<u>Amphora ovalis</u>	<u>Crucigenia quadrata</u>
<u>Amphora ovalis</u> v. <u>pediculus</u>	<u>Crucigenia</u> sp.
<u>Amphora</u> sp.	<u>Cryptomonas</u> sp.
<u>Anabaena circinalis</u>	<u>Cyclotella meneghiniana</u>
<u>Anabaena</u> sp.	<u>Cyclotella</u> sp.
<u>Ankistrodesmus braunii</u>	<u>Cymatopleura solea</u>
<u>Ankistrodesmus falcatus</u>	<u>Cymatopleura solea</u> v. <u>apiculata</u>
<u>Aphanothece</u> sp.	<u>Cymbella</u> sp.
<u>Asterionella formosa</u>	<u>Dactylococcopsis</u> sp.
Blue-Green unknown colonies	<u>Diatoma tenuis</u> v. <u>elongatum</u>
<u>Caloneis</u> sp.	<u>Diatoma vulgare</u>
<u>Caloneis ventricosa</u>	<u>Dictyosphaerium pulchellum</u>
<u>Caloneis ventricosa</u> v. <u>truncata</u>	<u>Dinobryon divergens</u>
<u>Ceratium hirundinella</u>	Dinoflagellate cysts
<u>Chlamydomonas</u> sp.	<u>Diploneis</u> sp.
<u>Chlorella</u> sp.	Flagellates
<u>Chroococcus limneticus</u>	<u>Fragilaria brevistrata</u>
<u>Chroococcus turgidus</u>	<u>Fragilaria capucina</u>
<u>Chroococcus</u> sp.	<u>Fragilaria construens</u>
<u>Closterium</u> sp.	<u>Fragilaria crotonensis</u>
<u>Closteriopsis longissima</u>	<u>Fragilaria intermedia</u>
(continues on right column)	<u>Fragilaria leptostauron</u>

TABLE 4 continued

<u>Fragilaria pinnata</u>	<u>Melosira</u> sp.
<u>Franceia droescheri</u>	<u>Melosira varians</u>
<u>Franceia ovalis</u>	<u>Meridion circulare</u>
<u>Franceia</u> sp.	<u>Microcystis aeruginosa</u>
<u>Glenodinium</u> sp.	<u>Microspora</u> sp.
<u>Gloeocystis</u> sp.	<u>Mougeotia</u> sp.
<u>Golenkinia radiata</u>	<u>Navicula capitata</u>
<u>Gomphonema</u> sp.	<u>Navicula costulata</u>
Green cells	<u>Navicula decussis</u>
Green cells, little	<u>Navicula gastrum</u>
Green cells, round, unknown	<u>Navicula</u> sp.
Green cells, tiny	<u>Navicula tripunctata</u>
Green colony, unknown	<u>Neidium dubium</u>
Greens, unknown, chains	<u>Nephrocystium</u> sp.
Greens, unknown, grapelike	<u>Nitzschia acicularis</u>
<u>Hypnodinium</u> sp.	<u>Nitzschia</u> sp.
<u>Kirchneriella</u> sp.	<u>Oocystis borgei</u>
<u>Lagerheimia citrifomis</u>	<u>Oocystis solitaria</u>
<u>Lagerheimia longiseta</u>	<u>Oocystis</u> sp.
<u>Lagerheimia longiseta</u> v. <u>major</u>	<u>Oocystis submarina</u>
<u>Lagerheimia</u> sp.	<u>Oscillatoria</u> sp.
<u>Mallomonas</u> sp.	<u>Pediastrum duplex</u>
<u>Melosira binderana</u>	<u>Pediastrum simplex</u>
<u>Melosira granulata</u>	<u>Pediastrum</u> sp.
<u>Melosira granulata</u> v. <u>angustissima</u>	<u>Peridinium</u> sp.
<u>Melosira islandica</u>	<u>Phormidium</u> sp.
<u>Melosira italica</u>	<u>Quadrigula chodatii</u>

(continues in right column)

TABLE 4 continued

<u>Quadrigula lacustris</u>	<u>Synedra ostenfeldii</u>
<u>Quadrigula</u> sp.	<u>Synedra</u> sp.
Round cells, broken colonies	<u>Synedra ulna</u>
<u>Scenedesmus abundans</u>	<u>Synedra ulna</u> v. <u>chaseana</u>
<u>Scenedesmus acuminatus</u>	<u>Synedra ulna</u> v. <u>danica</u>
<u>Scenedesmus armatus</u>	<u>Synedra vaucheriae</u> v. <u>fragilarioides</u>
<u>Scenedesmus bijuga</u>	<u>Tabellaria fenestrata</u>
<u>Scenedesmus bijuga</u> v. <u>alternans</u>	<u>Tetraedron lunula</u>
<u>Scenedesmus dimorphus</u>	<u>Tetraedron minimum</u>
<u>Scenedesmus incrassatulus</u>	<u>Tetraedron obesum</u>
<u>Scenedesmus opoliensis</u>	<u>Tetraedron pentaedricum</u>
<u>Scenedesmus quadricauda</u>	<u>Tetraedron regulare</u>
<u>Scenedesmus quadricauda</u> v. <u>maximus</u>	<u>Tetradasmus smithii</u>
<u>Scenedesmus</u> sp.	<u>Tetradasmus wisconsinensis</u>
<u>Schroederia judayi</u>	<u>Tetrastrum</u> sp.
<u>Sorastrum spinulosa</u>	<u>Treubaria setigerum</u>
Spores	<u>Tribonema</u> sp.
Spores, resting	Unknown cells
<u>Stephanodiscus</u> sp.	Unknown colonies
<u>Staurastrum</u> sp.,	<u>Westella</u> sp.
<u>Stauroneis</u> sp.	Zoospores
<u>Surirella angustata</u>	
<u>Surirella</u> sp.	
<u>Synedra acus</u>	
<u>Synedra delicatissima</u>	
<u>Synedra delicatissima</u> v. <u>angustissima</u>	
<u>Synedra filiformis</u>	
(continues in right column)	

Diversity Indices of the July 1970, and Earlier, Phytoplankton Collections

In this section we follow Wilhm and Dorris (1968),^{*} who developed from information theory a technique for evaluating the structure of bottom fauna communities. We have applied their technique to our phytoplankton collections because (1) the technique is considered to be very largely independent of sample size (allowing the use of our smaller, earlier collections); (2) the technique mathematically considers each component of the population collected; and, most important, (3) the technique is an accepted index of community structure by which to watch for changes in the phytoplankton community structure around the Cook Plant in the ensuing years.

Basically, the Wilhm and Dorris diversity index considers that, in a population composed of a few species or groups and with large numbers of individuals of each species or group, the uncertainty that any one organism collected will belong to a species or group already taken will be low (and the technique computes a low diversity index). Conversely, in a community composed of many species or groups, but with fewer numbers of individuals of any species or group, the uncertainty that any particular organism collected will belong to a previously recognized species or group is high (and the technique computes a high diversity index).

The computation of Wilhm and Dorris is

$$\bar{d} = - \sum (N_i/N) \log_2 (N_i/N) ,$$

in which (N_i/N) is the percentage of the population, N , that is represented by any one species or group, N_i , of the collection. Logarithms to the base 2 are natural logarithms multiplied by 1.44269; the logarithms are negative, and a

^{*}Wilhm, J.L., and Dorris, T.C. 1968. "Biological Parameters for Water Quality Criteria." BioScience 18(6):477-81.

negative summation is used to provide an answer in positive numbers. The over-bar on \bar{d} denotes a mean, for their method (extended) also yields maximum and minimum diversity indices.

NOTE: The average diversity index shown at the end of Table 6 is merely the arithmetical average of \bar{d} values of the individual station collections.

In accordance with our policy of continued analysis of our earlier surveys of the Cook Plant area, we have computed the Wilhm and Dorris diversity indices of our phytoplankton collections earlier than July 1970 (the collection on 25 April 1969 was not made by a comparable method and is not included). The station lists of phytoplankton collected from which these diversity indices have been computed are Tables 3, 4, 5, and 6 of Part VII of our report series relative to the Cook Plant. The results are given in Table 5.

TABLE 5. Diversity Indices of Phytoplankton Samples 1-1.3 Miles Off Cook Plant

Station and Date	Distance from Shore	Depth of Collection	Diversity Index, \bar{d}
CP-2 11 August 1969	1.3 miles	6 inches	3.64
COOK 4 October 1969	1.0 mile	15 meters	2.38
COOK 26 April 1970	1.0 mile	15 meters	3.11
COOK 6 June 1970	1.0 mile	15 meters	3.27
(and, for comparison, from the present report)			
DC-3 10 July 1970	1.25 miles	1 meter	3.60

TABLE 6. Numbers of Phytoplankton Species, Number of Individuals Per Milliliter and Diversity of the 10 July 1970 Survey

Station	Number of Species	Number of Individuals	Diversity Index
DC-1	23	390	3.18
DC-2	24	407	3.63
DC-3	30	647	3.60
DC-4	15	448	1.85
DC-5	12	286	2.88
DC-6	11	333	2.39
NDC-.25-1	26	458	3.39
NDC-.5-0	42	1,794	3.92
NDC-.5-1	43	504	3.88
NDC-.5-2	26	647	3.53
NDC-.5-3	17	528	2.89
NDC-1-0	36	3,052	3.90
NDC-1-1	31	1,244	3.88
NDC-1-2	20	974	1.65
NDC-1-3	25	543	3.28
NDC-2-0	36	1,180	4.27
NDC-2-1	43	940	4.05
NDC-2-2	21	504	3.85
NDC-2-3	21	601	3.46
NDC-2-4	20	515	2.91
NDC-4-0	30	1,856	4.01
NDC-4-1	46	3,024	3.89
NDC-4-2	42	1,521	4.01
NDC-4-3	19	277	2.85
NDC-4-4	19	331	3.40
NDC-7-1	46	1,594	3.78
NDC-7-2	50	11,523	1.09
NDC-7-3	41	1,081	3.92
NDC-7-4	17	1,344	2.77
NDC-7-5	21	220	3.29

TABLE 6 continued

Station	Number of Species	Number of Individuals	Diversity Index
SDC-.25-1	9	143	1.94
SDC-.5-0	40	1,038	3.90
SDC-.5-1	33	718	3.62
SDC-.5-2	17	278	2.84
SDC-1-0	33	1,396	3.81
SDC-1-1	27	830	3.33
SDC-1-2	19	757	2.03
SDC-1-3	16	386	2.75
SDC-2-0	34	962	3.55
SDC-2-1	29	1,012	3.58
SDC-2-2	13	265	2.55
SDC-2-3	18	337	3.23
SDC-2-4	12	316	2.29
SDC-4-0	40	1,104	4.22
SDC-4-1	31	567	3.56
SDC-4-2	26	798	3.08
SDC-4-3	18	438	2.84
SDC-4-4	17	331	3.15
SDC-7-1	32	632	3.68
SDC-7-2	42	13,274	0.49
SDC-7-3	37	630	3.54
SDC-7-4	26	712	3.20
SDC-7-5	23	413	2.88
Overall Average Diversity Index			3.20

In Table 6, the number of species or groups present, the number of individual cells per milliliter, and the diversity index for each phytoplankton sample of the 10 July 1970 survey are listed by stations. The field of diversity indices has been contoured and is shown in Figure 2.

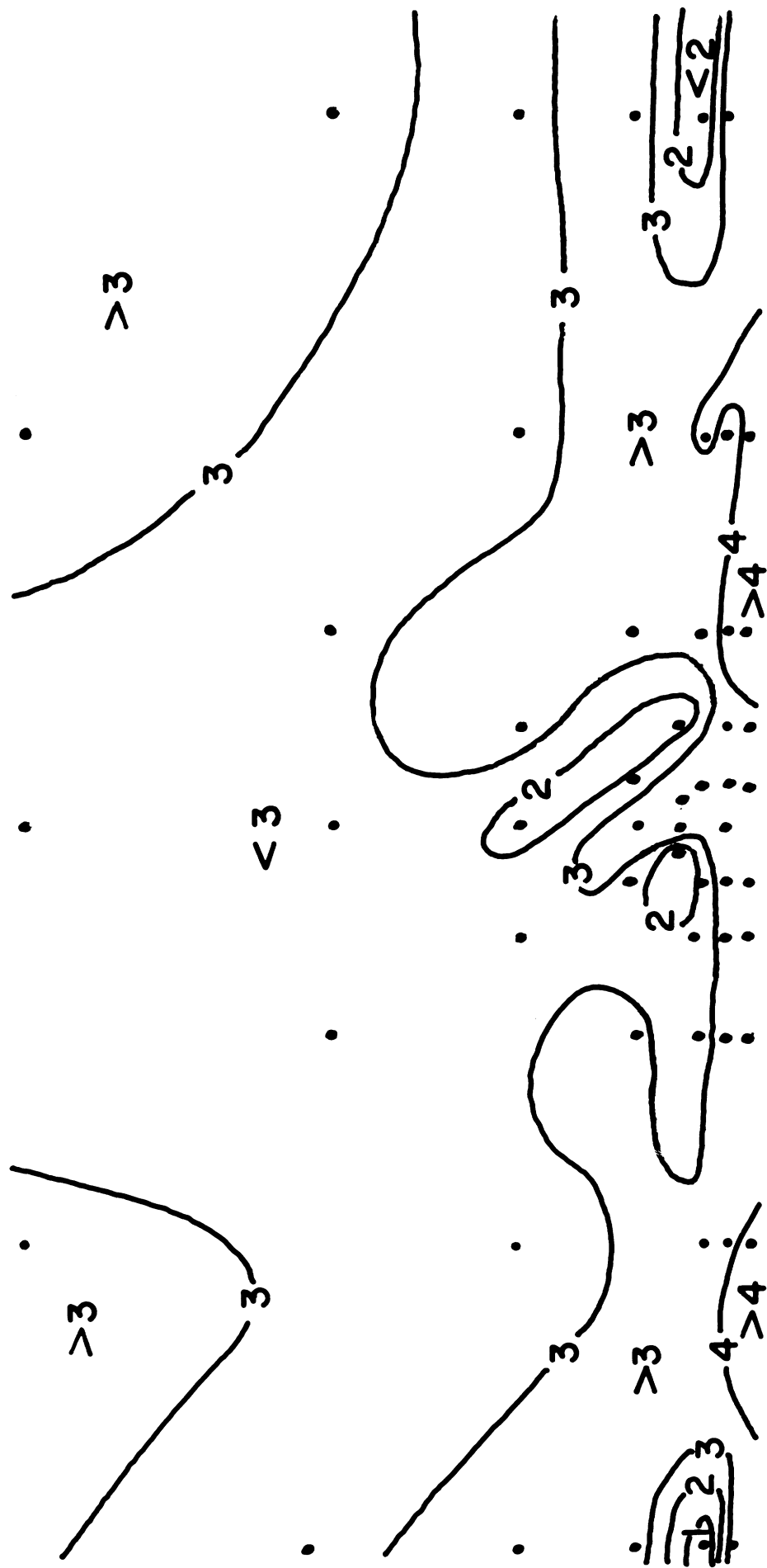
Comments on the Phytoplankton Collections

Consideration of the numbers of species collected, the numbers of individual phytoplankters, and of the diversity indices of the station collections (horizontally across Table 6) show only that the individual station collections were greatly different from each other. The adjacent stations, SDC-7-1, SDC-7-2, and SDC-7-3, for example, show variations in numbers of species or groups ranging from 32 to 42, variations of numbers of individuals per milliliter from 630 to 13,274, and variations of the diversity index from 0.49 (at SDC-7-2) to 3.68 (at SDC-7-1).

The conclusion being forced upon us is that small water masses, each with different biotic characteristics, move through the Cook Plant area. The data from our grab-sampling technique is the manifestation of uneven phytoplankton population distribution in these water masses. We have seen, but perhaps not fully appreciated, similar conditions before (see our conclusion in Part VII of our report series wherein floating-bag experiments at NIPSCO's Bailly Station produced only evidence of plankton patchiness). There are many other evidences of plankton patchiness shown in Table 6.

The demonstrable phytoplankton patchiness shown in Table 6 leads us to the conclusion that the overall average diversity index for this survey should be presented only as an objective mathematical summary of data from several

FIGURE 2. Phytoplankton Diversity Indices Contours.

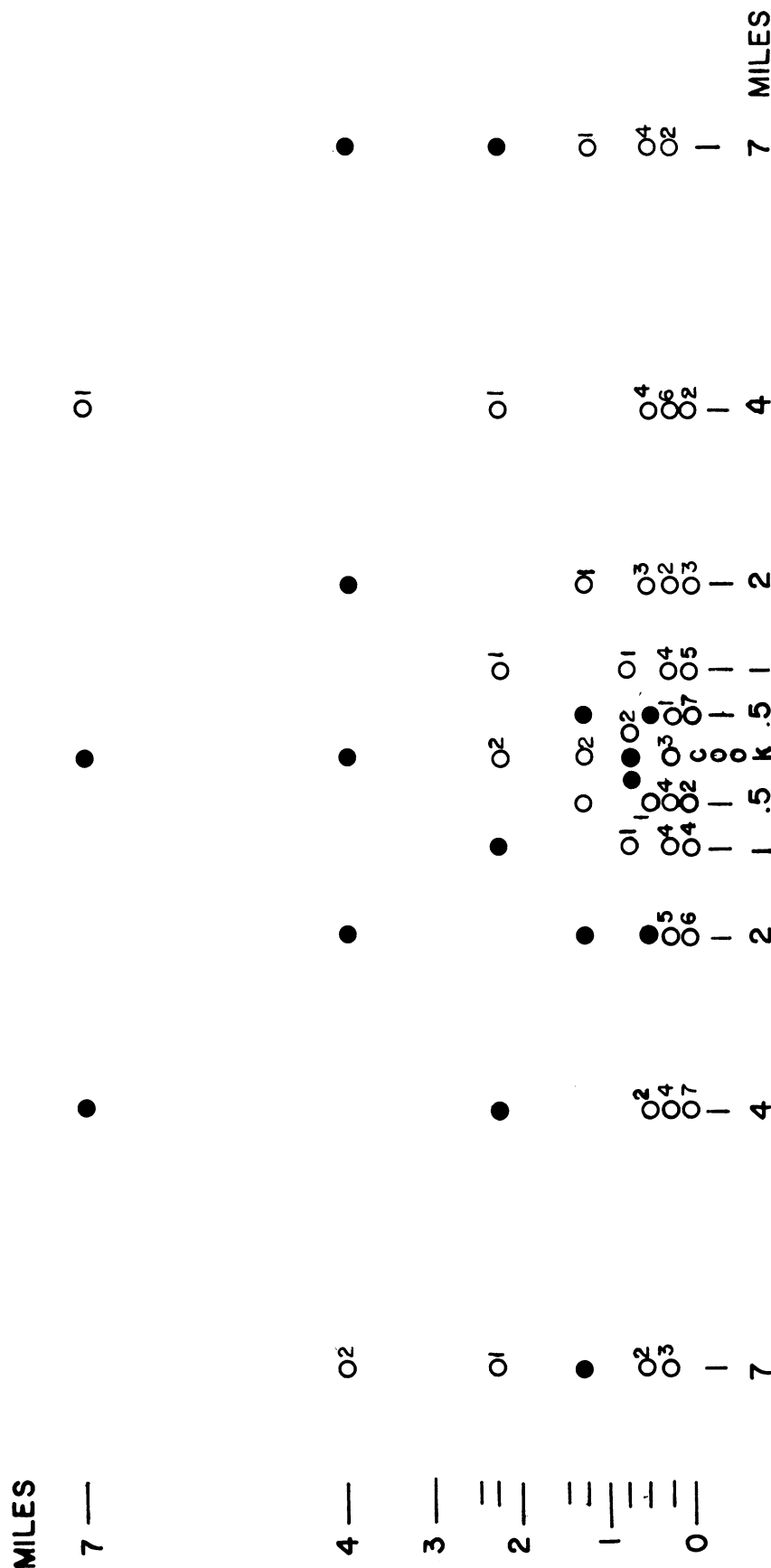


biologically different water masses. This figure will be retained for possible future usefulness.

Possible Influence of the St. Joseph River

Dr. E. F. Stoermer has provided a list of river-associated phytoplankters which he believes would, if heavily dominant in our Cook Plant surveys, indicate an undesirable amount of influence by the St. Joseph River on the environs of the Cook Plant. Our phytoplankton collections at Cook Plant on 10 July 1970 have been inspected for the presence and degree of numerical dominance of these species. In no station did all 13 of the species occur. In 16 of the 54 stations none of the proscribed species occurred. When numbers of these species are plotted on the map of Cook Plant sampling stations (Figure 3), the only pattern that emerges is of their more frequent occurrence in shallow water, not a surprising result since these species also are known as shallow-water lake plankters. Thus, the evidence from the 10 July 1970 survey shows no demonstrable effect of the St. Joseph River on the Cook Plant plankton. Similar analysis will be made for each of the subsequent surveys.

FIGURE 3. Map of Cook Plant Sampling Stations Showing the Distribution of River-Associated Phytoplankton and the Number of Species Present at Each Station.



● = River associated phytoplankton not present.

○ = River associated phytoplankton present.
The number of species observed is indicated by the adjacent number.

A.5 Study of Zooplankton

Zooplankton Techniques

Zooplankton collections were made by a vertical haul, from bottom to surface, with a #5-mesh (0.282-mm average openings) net of .5-m diameter. A propeller-type flowmeter was affixed in the center of the net mouth to obtain quantitative measurement of the volume of water sampled by the net. The volume of water that passed through the net was indicated by the number of revolutions made by the flowmeter propeller; this figure was recorded and later converted to an equivalent expressed in liters of water.

The net was then raised above the surface and rinsed to free organisms impacted on the net and to concentrate the sample in the collecting jar tied on the narrow cod-end of the net. Then, excess water in the brim-full jar was decanted through a small area of the net just above the cod-end. This small area of the net was then rinsed carefully to wash all zooplankters into the collecting jar with a minimum amount of water. The jar was removed from the net, and Koechies fixative, a solution of formalin and sugar, was added as a preservative. An identification label containing pertinent collection data was placed in the jar. The jar was capped and labeled exteriorly for delivery to the laboratory.

In the laboratory, the sample volume was measured by transferring the entire sample to a graduated cylinder. The entire sample then was returned to the collecting jar and mixed thoroughly and continuously with a magnetic stirrer while 1-ml subsamples were extracted with a Henson-Stempel pipette. Each subsample was placed in a depression in a clear glass spot plate. Each depression

received a few drops of soap solution to break the surface tension film and allow the zooplankton to settle to the bottom for easier counting. A variable-magnification binocular microscope was used, with transmitted light, for counting and identification. As many 1-ml subsamples as were necessary to obtain good statistical parameters were counted. The number of zooplankton per liter of water was obtained by conversion with standard factors. The station collections of zooplankton on 10 July 1970 are given in Table 7.

Zooplankton Abundances

The Cyclopoid copepod zooplankton group exhibited the highest abundances during this survey, reaching 21.99 individuals per liter at station SDC-4-4, 13.52 individuals per liter at station DC-6, and 13.44 individuals per liter at station NDC-4-4; these copepods, however, were not present in the collection from station SDC-4-3. Other maximum abundances during this survey were: Diaptomus copepods, with 12.66 individuals per liter at station SDC-4-4 (this was the highest abundance for this group, greatly exceeding its abundances at other stations); Bosmina cladocerans, with 12.62 individuals per liter at station SDC-2-1 (a single-station maximum approached only by 9.60 individuals per liter at station SDC-7-3); Polyphemus cladocerans, with 2.35 individuals per liter at station DC-1 (at all other stations this group had abundances of less than 1 individual per liter); and Asplanchna rotifers, with 1.42 organisms per liter at station SDC-2-1 (abundances from other stations closely approached this figure). Actual numerical abundances of zooplankton in the collections of this survey indicate primarily the patchiness in spatial distribution of the zooplankton.

In seeking to establish a biological baseline against which future comparisons may be made, we list below the dominance frequencies of the zooplankton groups of the 10 July 1970 survey. Although the Cyclopoid copepods were occasionally present in higher numbers, *Bosmina* cladocerans dominated the samples most frequently.

<u>Zooplankton Group</u>	<u>Dominant or Codominant Occurrences</u>
Cyclopoid copepods	8
Diaptomus copepods	0
<i>Bosmina</i> cladocerans	37
Polyphemus cladocerans	2
<i>Asplanchna</i> rotifers	0

Just as the phytoplankton samples in the preceding section of this report required that the Cook Plant area of Lake Michigan be put on record as being a "diatom" lake on 10 July 1970, the zooplankton collections of the same day require that the Cook Plant region of the lake be recorded as a "*Bosmina*" lake.

Diversity Indices of the July 1970, and Earlier, Zooplankton Collections

In the preceding section on phytoplankton, we have introduced and discussed the Wilhm and Dorris computation of the diversity index. In this section, their index is applied to the zooplankton collections because it appears to be, at present, the best means by which the zooplankton community can be represented objectively in a way that can be used in watching for changes in community composition over time.

We, at this time at least, attach no pollution-related interpretations to the numbers for diversity indices that are computed. They are used merely as objective parameters against which comparisons over time are to be made.

TABLE 7. Zooplankton, 10 July 1970. Samples by Vertical Haul of Metered #5 Net. Organisms Per Liter.

Stations	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6
Organisms						
Copepods:						
Diaptomus	0.26	0.17	0.26	0.49	1.54	5.02
Epischura	-	-	0.01	0.01	0.01	-
Eurytemora	-	-	-	-	-	-
Limnocalanus	-	-	-	-	-	0.02
Senecella	-	-	-	-	-	-
Cyclopoids	0.05	0.38	0.11	0.79	3.96	13.52
Harpacticoids	-	0.01	-	-	-	-
Cladocerans:						
Alona	-	0.02	-	-	-	-
Bosmina	0.56	1.69	2.49	3.27	1.86	4.61
Ceriodaphnia	-	0.04	-	0.03	0.02	0.02
Daphnia	-	0.02	0.02	0.21	0.17	0.13
Diaphanosoma	-	-	-	-	-	-
Eurycercus	-	-	-	-	-	-
Holopedium	-	0.01	0.02	0.03	-	-
Leptodera	-	0.04	0.01	-	-	-
Polyphemus	2.35	0.47	0.11	0.14	0.25	0.39
Rotifers:						
Asplanchna	0.42	0.34	0.21	0.14	0.04	0.05

TABLE 7 continued

Stations Organisms	NDC.25-1	NDC-.5-1	NDC-.5-2	NDC-.5-3	NDC-1-1
Copepods:					
Diaptomus	0.30	0.16	0.22	0.41	0.13
Epischura	-	-	-	-	-
Eurytemora	-	-	-	-	-
Limnocalanus	-	-	-	-	-
Senecella	-	-	-	-	-
Cyclopoids	0.34	0.06	0.24	0.24	0.18
Harpacticoids	-	-	-	0.01	-
Cladocerans:					
Alona	-	0.06	0.02	-	0.03
Bosmina	3.36	1.07	2.20	3.22	1.50
Ceriodaphnia	0.04	-	0.04	0.02	0.03
Daphnia	0.02	-	-	0.04	0.03
Diaphanosoma	-	-	-	-	-
Eurycercus	-	-	-	-	-
Holopedium	-	-	-	0.01	-
Leptodera	-	-	-	0.01	-
Polyphemus	0.98	0.14	0.82	0.25	0.41
Rotifers:					
Asplanchna	0.68	0.53	0.98	0.23	0.52

TABLE 7 continued

Stations Organisms	NDC-1-2	NDC-1-3	NDC-2-1	NDC-2-2	NDC-2-3
Copepods:					
Diaptomus	0.27	0.41	2.02	-	0.26
Epischura	-	-	0.02	-	-
Eurytemora	-	-	-	-	-
Limnocalanus	-	-	-	-	-
Senecella	-	-	-	-	-
Cyclopoids	0.24	0.32	4.43	-	0.24
Harpacticoids	-	-	-	-	-
Cladocerans:					
Alona	0.01	0.36	-	-	-
Bosmina	1.58	1.17	4.72	-	2.31
Ceriodaphnia	-	-	0.03	-	0.01
Daphnia	0.02	0.01	0.35	-	0.04
Diaphanosoma	-	-	-	-	-
Eurycercus	-	-	-	-	-
Holopedium	0.01	-	0.01	-	0.02
Leptodera	-	-	0.01	-	0.01
Polyphemus	0.58	0.36	0.06	-	0.31
Rotifers:					
Asplanchna	0.42	0.04	0.13	-	0.32

TABLE 7 continued

Stations Organisms	NDC-2-4	NDC-4-1	NDC-4-2	NDC-4-3	NDC-4-4
Copepods:					
Diaptomus	2.02	0.27	0.21	0.51	6.60
Epischura	0.02	0.02	0.02	0.01	0.01
Eurytemora	-	-	-	-	-
Limnocalanus	-	-	-	-	0.03
Senecella	-	-	-	-	-
Cyclopoids	4.43	0.07	0.17	0.70	13.44
Harpacticoids	-	-	-	0.01	-
Cladocerans:					
Alona	-	-	0.01	-	-
Bosmina	4.72	1.96	1.58	1.59	3.77
Ceriodaphnia	0.03	0.02	0.02	0.07	0.02
Daphnia	0.35	0.02	0.01	0.08	0.23
Diaphanosoma	-	-	1.58	-	-
Eurycercus	-	-	0.02	-	-
Holopedium	0.01	0.02	0.02	0.02	0.01
Leptodera	0.01	-	0.01	0.01	-
Polyphemus	0.06	0.50	0.11	0.25	0.13
Rotifers:					
Asplanchna	0.13	0.38	0.25	0.24	0.05

TABLE 7 continued

Stations Organisms	NDC-7-1	NDC-7-2	NDC-7-3	NDC-7-4	NDC-7-5
Copepods:					
Diaptomus	0.66	1.13	0.81	0.44	0.99
Epischura	-	-	-	0.04	0.03
Eurytemora	-	-	-	-	-
Limnocalanus	-	-	-	-	-
Senecella	-	-	-	-	-
Cyclopoids	1.33	2.02	0.93	0.55	3.19
Harpacticoids	-	-	-	0.01	-
Cladocerans:					
Alona	0.08	0.42	0.14	0.01	-
Bosmina	5.72	4.22	1.62	1.11	1.60
Ceriodaphnia	-	0.07	-	0.04	0.03
Daphnia	0.05	0.13	0.05	0.04	0.14
Diaphanosoma	-	-	-	-	-
Eurycercus	0.05	-	-	0.01	0.01
Holopedium	-	0.05	0.01	0.01	0.01
Leptodera	-	-	0.03	0.01	0.01
Polyphemus	0.23	0.15	0.47	0.16	0.10
Rotifers:					
Asplanchna	0.20	0.37	0.29	0.10	0.03

TABLE 7 continued

Stations Organisms	SDC-.25-1	SDC-.5-1	SDC-.5-2	SDC-.5-3	SDC-1-1
Copepods:					
Diaptomus	0.37	0.25	0.08	0.60	0.08
Epischura	-	-	-	-	-
Eurytemora	-	-	-	-	-
Limnocalanus	-	-	-	-	-
Senecella	-	-	-	-	-
Cyclopoids	0.48	0.23	0.23	0.38	0.25
Harpacticoids	-	-	-	-	-
Cladocerans:					
Alona	0.04	-	0.02	-	0.06
Bosmina	4.31	4.88	2.25	3.53	3.23
Ceriodaphnia	0.02	-	-	0.07	-
Daphnia	0.08	0.02	-	0.15	-
Diaphanosoma	-	-	-	-	-
Eurycercus	-	-	-	-	-
Holopedium	0.03	-	-	0.03	-
Leptodera	-	0.02	-	0.01	0.03
Polyphemus	0.69	0.18	0.66	0.21	0.45
Rotifers:					
Asplanchna	1.08	0.44	1.26	0.36	0.48

TABLE 7 continued

Stations Organisms	SDC-1-2	SDC-1-3	SDC-2-1	SDC-2-2	SDC-2-3
Copepods:					
Diaptomus	0.34	0.68	1.78	0.08	0.35
Epischura	0.05	0.02	0.24	0.04	-
Eurytemora	-	-	-	-	-
Limnocalanus	-	-	-	-	-
Senecella	-	-	-	-	-
Cyclopoids	0.44	0.66	3.44	0.10	0.26
Harpacticoids	-	0.01	-	0.04	0.01
Cladocerans:					
Alona	0.08	0.42	0.18	0.02	0.01
Bosmina	3.93	3.50	12.62	2.24	1.65
Ceriodaphnia	0.03	0.06	0.06	-	0.05
Daphnia	0.03	0.12	0.06	-	0.03
Diaphanosoma	-	-	-	-	-
Eurycercus	-	-	-	-	-
Holopedium	0.09	0.04	-	0.02	0.04
Leptodera	-	0.04	0.12	-	0.05
Polyphemus	0.44	0.12	0.47	0.38	0.25
Rotifers:					
Asplanchna	1.20	0.32	1.42	0.50	0.22

TABLE 7 continued

Stations Organisms	SDC-2-4	SDC-4-1	SDC-4-2	SDC-4-3	SDC-4-4
Copepods:					
Diaptomus	1.68	0.33	0.08	0.40	12.66
Epischura	0.01	-	0.05	0.04	-
Eurytemora	-	-	-	-	-
Limnocalanus	-	-	-	-	0.09
Senecella	-	-	-	-	-
Cyclopoids	2.59	0.08	0.16	-	21.99
Harpacticoids	-	-	-	0.04	-
Cladocerans:					
Alona	-	-	0.06	-	-
Bosmina	4.75	1.69	1.08	2.74	9.83
Ceriodaphnia	-	-	-	-	-
Daphnia	0.19	0.03	-	0.12	0.35
Diaphanosoma	-	-	-	-	-
Eurycercus	-	-	-	-	-
Holopedium	-	0.02	-	-	-
Leptodera	0.01	-	0.02	0.03	-
Polyphemus	0.23	0.14	0.35	0.08	0.18
Rotifers:					
Asplanchna	0.08	0.56	0.32	0.25	0.08

TABLE 7 continued

Stations Organisms	SDC-7-1	SDC-7-2	SDC-7-3	SDC-7-5
Copepods:				
Diaptomus	0.31	1.05	6.20	1.34
Epischura	0.04	-	0.19	0.03
Eurytemora	-	-	-	-
Limnocalanus	-	-	-	-
Senecella	-	-	-	-
Cyclopoids	0.61	2.73	6.86	2.78
Harpacticoids	-	-	-	0.02
Cladocerans:				
Alona	0.19	0.46	0.20	0.03
Bosmina	3.51	3.97	9.60	1.05
Ceriodaphnia	0.04	-	0.05	-
Daphnia	-	-	0.79	0.14
Diaphanosoma	-	-	-	-
Eurycercus	-	0.03	0.23	-
Holopedium	-	-	0.05	0.02
Leptodera	-	0.06	0.06	0.01
Polyphemus	3.66	0.99	0.64	0.12
Rotifers:				
Asplanchna	0.15	0.78	0.88	0.07

The diversity indices have been computed from the station collections of 10 July 1970 given in Table 7. Table 8 gives indices computed from earlier collections.

TABLE 8. Diversity Indices of Zooplankton Samples from 1-1.3 Miles Off Cook Plant.

Station and Date	Distance from Shore	Diversity Index
COOK 4 October 1969	1.0 mile	2.0
COOK 26 April 1970	1.0 mile	1.2
COOK 6 June 1970	1.0 mile	1.4
(and, for comparison, from the present report)		
DC-3 10 July 1970	1.25 miles	1.3

Table 9 presents station by station: (1) the dominant organism in terms of numbers in each station collection, (2) the total number of zooplankton organisms per liter captured by the #5 plankton net, and (3) the diversity indices as computed from the data of Table 7. At the end of Table 9 there is presented the overall average diversity index for this day's collections, which is given as a possible summary parameter for the station collections.

Comments on the Zooplankton Collections

The numbers of zooplankton per liter found in the water in the Cook Plant area varied considerably. The offshore samples tended to exhibit higher abundances; however, some stations closer to shore produced samples with high abundances of zooplankton. Table 9 lists, by station, the total number of organisms

TABLE 9. The Numerically Dominant Zooplankters, Total Numbers of Zooplankters Per Liter (Metered #5 Net), and Diversity Indices of the 10 July 1970 Collections.

Station	Dominant Organisms	Total Organisms/Liter	Diversity Index
DC-1	Polyphemus	3.64	1.5
DC-2	Bosmina	3.19	2.1
DC-3	Bosmina	3.24	1.3
DC-4	Bosmina	5.11	1.7
DC-5	Cyclopoids	7.85	1.8
DC-6	Cyclopoids	23.76	1.6
NDC-.25-1	Bosmina	5.72	1.8
NDC-.5-1	Bosmina	2.02	1.8
NDC-.5-2	Bosmina	4.52	2.0
NDC-.5-3	Bosmina	4.44	1.3
NDC-1-1	Bosmina	2.83	2.0
NDC-1-2	Bosmina	3.13	2.0
NDC-1-3	Bosmina	2.67	2.2
NDC-2-1	Bosmina & Cyclopoids	11.78	1.8
NDC-2-2	missing		
NDC-2-3	Bosmina	3.52	1.7
NDC-2-4	Bosmina & Cyclopoids	11.78	1.8
NDC-4-1	Bosmina	3.26	1.8
NDC-4-2	Bosmina	2.41	1.8
NDC-4-3	Bosmina	3.13	2.4
NDC-4-4	Cyclopoids	24.29	1.6
NDC-7-1	Bosmina	8.32	1.5
NDC-7-2	Bosmina	8.19	2.6
NDC-7-3	Bosmina	4.35	2.4
NDC-7-4	Bosmina	2.53	2.3

TABLE 9 continued

Station	Dominant Organisms	Total Organisms/Liter	Diversity Index
NDC-7-5	Cyclopoids	6.14	1.8
SDC-.25-1	Bosmina	7.10	1.8
SDC-.5-1	Bosmina	6.04	1.1
SDC-.5-2	Bosmina	4.50	1.8
SDC-.5-3	Bosmina	5.34	1.7
SDC-1-1	Bosmina	4.52	1.4
SDC-1-2	Bosmina	6.58	1.9
SDC-1-3	Bosmina	5.57	1.8
SDC-2-1	Bosmina	20.39	1.8
SDC-2-2	Bosmina	3.42	1.0
SDC-2-3	Bosmina	2.92	2.1
SDC-2-4	Bosmina	9.54	1.8
SDC-4-1	Bosmina	2.85	1.7
SDC-4-2	Bosmina	2.12	2.1
SDC-4-3	Bosmina	3.43	1.4
SDC-4-4	Cyclopoids	45.18	1.6
SDC-7-1	Polyphemus & Bosmina	8.51	1.8
SDC-7-2	Bosmina	10.04	2.2
SDC-7-3	Bosmina	25.75	2.0
SDC-7-4	broken		
SDC-7-5	Cyclopoids	5.61	1.9
Overall Average Diversity Index -----			1.8

per liter for each sample. Zooplankton patchiness is evident, although not as pronounced as the phytoplankton patchiness. We cite stations NDC-2-1, NDC-2-4, DC-6, NDC-.5-1, SDC-2-1, SDC-2-2, SDC-2-3, and SDC-2-4 as examples.

A.7 Study of Benthic Organisms

Benthos Techniques

Benthic organisms were collected by use of the ponar grab-sampler. Two grabs were combined and passed together through a washing device in which the benthic organisms were retained on a 0.5-mm mesh screen. In subsequent counting, the counts were divided by two to give the average of the duplicate samples. Organisms from the washing device then were collected into pint mason jars, labeled internally and externally, preserved with buffered formalin, and returned to the laboratory for processing. In the laboratory, the samples were concentrated on a small mesh net, and transferred with minimum fluid to the counting tray.

For general survey purposes, the benthos are counted into the groups: amphipods, oligochaetes, sphaeriids, chironomids, and others (mostly leeches and snails). The averaged counts were converted by standard factors to give numbers of organisms per square meter. The counted samples are preserved by appropriate standard museum techniques and retained as a reference collection.

We are well aware of some weaknesses in our treatment of benthos collections. We know that sorting and counting into family groups as outlined above is a compromise between the desirable identification to species and the time-wise impracticality of such identifications to species. For the same reason, another compromise has been necessary to expedite enumeration of the oligochaetes. These worms tend to fragment during processing, and it is not possible to rapidly distinguish fragments from whole individuals. Therefore, to estimate oligochaete abundance, all worms and parts of worms were counted, and the total

divided by three. More detailed examination of some samples has shown that this factor actually varies from sample to sample, but we feel that our procedure is adequate to distinguish any major features of oligochaete distribution. We have tried the computation of diversity indices from our higher-taxon separation of benthos, and have found that they are unrealistic; diversity indices will not be applied to our benthos collections for this reason. In view of the necessity to maintain continuity of method, we will retain the benthos-handling routine outlined in the preceding paragraphs.

Benthos Abundances

The abundances of benthic organisms collected on 10 July 1970 are presented in Table 10. In this table the collections are arranged into six parts, each of which contains stations at different distances from shore and in roughly the same water depths. Location of stations by distance from shore is navigationally convenient and desirable. It bears upon biological collections through its effect upon water depth, which in turn bears upon biota through its effects on wave action, bottom stability, food materials remaining in the area, and other factors. The bottom in the area of Cook Plant is gently, but not uniformly, sloping and its sand is known to move with storms and currents. Because of this, the variations of depth at given distances from shore contain transient factors due to bottom movement. The two deepest stations were characterized by fine sediments with a high proportion of clay, indicating the occurrence of a sedimentation boundary at approximately 130 ft.

As a whole, benthic macrofauna increased strongly with depth between 15 and 80 ft. This was also true of the major taxa amphipods (represented by the single

TABLE 10. The Benthos Collections of 10 July 1970. Numbers Per Meter².

Station	Depth (ft)	Amphipods	Oligochaetes	Sphaeriids	Chronomids	Others
<i>Part 1. Stations 1/4 Mile Offshore</i>						
NDC-7-1	22	8	17	0	86	8L
NDC-4-1	17.5	0	0	0	295	0
NDC-2-1	18.5	0	0	0	no data	0
NDC-1-1	18.5	0	17	0	504	0
NDC-.5-1	20.5	0	26	0	113	0
DC-1	19	86	399	8	452	17L
SDC-.5-1	19.5	0	0	0	226	0
SDC-1-1	13.5	0	0	0	278	0
SDC-2-1	18	0	17	0	660	0
SDC-4-1	14	8	0	0	95	0
SDC-7-1	14	26	8	0	86	0
Averages		11.6	44	0.7	254	2.3
<i>Part 2. Stations 1/2 and 3/4 Mile Offshore</i>						
NDC-7-2	27.5	86	982	69	86	17L
NDC-4-2	29	339	521	165	147	0
NDC-2-2	21.5		missing			
NDC-1-2	33.5*	747	1,817	321	113	8L
NDC-.5-2	26.5		missing			
DC-2	40.5*	1,582	547	243	147	0
SDC-.5-2	28.5	156	686	113	60	8S
SDC-1-2	40*	1,417	2,556	730	243	34L
SDC-2-2	27.5	121	843	139	165	0
SDC-4-2	37.5	95	765	78	269	0
SDC-7-2	26.5	139	1,104	121	147	8S
Averages		520	1,091	220	153	8.3

* 3/4 mile offshore.

TABLE 10 continued

Station	Depth (ft)	Amphipods	Oligochaetes	Sphaeriids	Chronomids	Others
<i>Part 3. Stations 1 1/4 Miles Offshore</i>						
NDC-7-3	48	556	573	26	43	8L
NDC-2-3	51	139	1,104	34	34	8L
NDC-.5-3	56.5	78	3,738	1,886	104	17S 52L
DC-3	56.5	5,382	860	956	121	0
SDC-.5-3	54.5	2,278	2,608	217	34	17L
SDC-2-3	51.5	721	8,781	921	69	17L
SDC-7-3	51.5	1,704	660	104	130	0
Averages		1,550	2,618	592	76	17
<i>Part 4. Stations 2 1/4 Miles Offshore</i>						
NDC-7-4	52.5	495	78	34	0	0
NDC-4-3	55.5	1,973	78	34	43	0
NDC-1-3	57.5	4,243	3,199	1,982	513	104L 43S
DC-4	65.5	695	3,869	2,634	486	208L
SDC-1-3	61.5	3,756	1,165	652	130	52L
SDC-4-3	59.5	547	2,825	921	78	52L 43S
SDC-7-4	53.5	4,573	1,747	226	0	8L
Averages		2,326	1,852	926	179	73
<i>Part 5. Stations 4 Miles Offshore</i>						
NDC-7-5	71.5	1,843	5,695	1,121	252	78L
NDC-2-4	74.5	10,451	6,008	278	52	0
DC-5	79.5	7,668	4,590	704	43	26L
SDC-2-4	72.5	2,825	4,617	1,356	286	34L
SDC-7-5	70.5	2,425	2,825	947	295	95L
Averages		5,042	4,747	881	186	47

TABLE 10 continued

Station	Depth (ft)	Amphipods	Oligochaetes	Sphaeriids	Chronomids	Others
<i>Part 6. Stations 7 Miles Offshore</i>						
NDC-4-4	134.5	5,208	5,686	617	104	34M
DC-6	130.5	939	1,365	147	34	17L
SDC-4-4	102.5	1,199	5,625	573	52	34L 17S
Averages		2,449	4,225	446	63	34

species Pontoporeia affinis), oligochaetes, and sphaeriids. Chironomids were present in low abundance over much of the area, and dominated the benthos in depths less than about 20 ft.

On 10 July 1970, the water depths at 1/4 mi from shore were slightly deeper directly in front of the plant site. This condition was reflected in higher (but still low) benthos collections directly in front of the plant site (see station DC-1 collections in comparison to collections at adjacent NDC stations north and SDC stations south of the plant site). To a lesser extent, this condition is shown also in Part 2 of Table 10, though it should be noted that stations NDC-1-2, DC-2, and SDC-1-2 were at 3/4 mi from shore, while the rest were at 1/2 mi. The tendency for deeper water and higher collections continues to be evident through Part 5 of the table, which presents station collections at 4 mi from shore. It is not present in Part 6, which gives collections at 7 mi from shore. At present we do not know whether the increased depth in front of the plant site is a temporary feature due to transient conditions of bottom movement or a permanent feature.

In spite of the deeper water in front of the plant site, the benthos collections at 1/4 mi from shore clearly demonstrate a relatively sterile zone or relative biological desert there, populated mainly by chironomids. If the Cook Plant outfalls go in at the planned 1160 ft from shore, they will be in this relatively deserted zone, where there is little benthos to be damaged. If the outfalls were to be placed at 1/2 mi from shore, they still would be in an area of reduced benthos.

The Benthos Species List

Detailed study of the benthos reference collection from this survey has been carried out and the list of resident benthos of that day has been prepared. It is presented in Table 11. Altogether, 38 kinds of benthic macrofauna were distinguished, and many of these were identified to the species level, or larval type in the case of chironomids. The only animal listed as a single taxon, but which included several species, is Pisidium.

Comparisons of the types of chironomids and oligochaetes with other areas of the Great Lakes revealed a mixture of "oligotrophic" and "eutrophic" conditions (as defined by indicator species) in the Cook Plant area during this survey. Future publications will deal with these relationships.

Application of the diversity index to the samples provided no additional insight into the ecology of the area, for the values varied so much that their significance was ambiguous. The cause of many of the low diversity values was the high proportion of Pontoporeia in the samples.

TABLE 11. Species List, Cook Plant Benthos Survey
July 1970

Arthropoda	
Crustacea	
Amphipoda	
	<u>Pontoporeia affinis</u>
Mysidacea	
	<u>Mysis relicta</u>
Insecta	
Diptera	
	Chironomidae (larval types, not species)
	<u>Chironomus fluviatilis</u> -group
	<u>C. anthracinus</u> -group
	<u>C. halophilus</u> -group
	<u>Kiefferulus</u> sp.
	<u>Cryptochironomus</u> sp. 1
	<u>C. sp. 2</u>
	<u>Parachironomus</u> cfr. <u>demeijerei</u>
	<u>Paracladopelma</u> cfr. <u>galaptera</u>
	<u>P. cfr. obscura</u>
	<u>Polypedilum</u> cfr. <u>scalaenum</u>
	<u>P. fallax</u> -group
	Tanytarsini sp.
	<u>Procladius</u> sp. (?spp.)
	<u>Monodiamesa</u> cfr. <u>bathyphila</u>
	<u>Heterotrissocladius</u> cfr. <u>subpilosus</u>
Annelida	
Oligochaeta	
	Lumbriculiidae
	<u>Stylodrilus heringianus</u>
	Tubificidae
	<u>Limnodrilus hoffmeisteri</u>
	<u>L. angustipenis</u>
	<u>L. cervix</u>

TABLE 11 continued

	<u>L. profundicola</u>
	<u>Aulodrilus americanus</u>
	<u>Potamothrix moldaviensis</u>
	<u>P. vejovskyi</u>
	<u>Pelosclex freyi</u>
	<u>P. variegatus</u>
	<u>Tubifex tubifex</u>
Hirudinea	
	<u>Helobdella stagnalis</u>
	<u>Glossiphonia complanata</u>
Mollusca	
Pelecypoda	
Sphaeriidae	
	<u>Sphaerium striatinum</u>
	<u>S. corneum</u>
	<u>S. nitidum</u>
	<u>S. transversum</u>
	<u>Sphaerium</u> sp.
	<u>Pisidium</u> spp.
Gastropoda	
	<u>Lymnaea</u> sp.
	<u>Valvata</u> sp.

Appendix A

PHYSICAL MEASUREMENTS, 10 JULY 1970

<u>Station</u>	DC-1	DC-2	DC-3	DC-4	DC-5	DC-6	NDC-.25-1	NDC-.5-1
<u>Time, EST</u>	1508	1456	1523	1537	1557	1623	1454	
<u>Wind Direction</u>			NW		NW	NW		
<u>Wind Speed</u>			7 knots		9 knots	9 knots		
<u>Sea Height, ft</u>			2 ft		2 ft	2 ft		
<u>Weather</u>			partly cloudy hazy		partly cloudy hazy	partly cloudy hazy		
<u>Secchi Disc</u>	3.2	3.9	4.0	3.8	4.8	8.0	3.8	1.7
<u>Water Color</u>	slightly milky brownish green	slightly milky brownish blue green	slightly milky brownish green	slightly milky brownish green	milky blue green	clear blue green	slightly milky brownish green	milky light green
<u>Surface Water Temperature, °C</u>	20.9°C	20.9°C	20.9°C	20.7°C	20.2°C	19.6°C	21.3°C	19.7°C
<u>Water Depth, ft</u>	19.0 ft	40.5 ft	56.5 ft	65.5 ft	79.5 ft	130.5 ft	38.0 ft	20.5 ft
<u>Bottom Type</u>	silty fine brown sand	silty fine brown sand	silty fine brown sand	half inch tan clayey fine sand over gray clayey fine sand	silty medium speckled brown sand	half inch tan soft slightly sandy clay over gray soft slightly sandy clay	silty fine brown sand	silty coarse brown sand

Appendix A continued

<u>Station</u>	NDC-.5-2	NDC-.5-3	NDC-1-1	NDC-1-2	NDC-1-3	NDC-2-1	NDC- 2-2	NDC-2-3
<u>Time, EST</u>	1419	1431	0942	1340	1400	0951	1234	1248

Wind Direction

NW

Wind Speed

9 knots

Sea Height, ft

Weather

partly
cloudy
hazy

<u>Secchi Disc</u>	3.8	4.0	1.25	2.8	4.5	2.0	2.8	4.5
<u>Water Color</u>	milky blue green	slightly milky blue green	milky brownish green	slightly milky blue green	slightly milky blue green	milky brownish green	milky light green	slightly milky blue green
<u>Surface Water Temperature, °C</u>	20.5°C	20.8°C	19.9°C	20.5°C	20.2°C	19.8°C	20.4°C	20.4°C
<u>Water Depth, ft</u>	26.5 ft	56.5 ft	18.5 ft	33.5 ft	57.5 ft	18.5 ft	21.5 ft	51.0 ft
<u>Bottom Type</u>	silty fine brown sand	clayey silty fine brown sand with inclusions of gray "organic" material	silty brown coarse sand	silty fine sand	half inch tan clayey fine silty sand over very gray silty fine sand	silty medium sand	hard unable to sample abundant periphyton	silty coarse sand and pebbles

Appendix A continued

<u>Station</u>	NDC-2-4	NDC-4-1	NDC-4-2	NDC-4-3	NDC-4-4	NDC-7-1	NDC-7-2	NDC-7-3
<u>Time, EST</u>	1312	1015	1050	1100	1137	2317	2326	
<u>Wind Direction</u>	NW	NW			NW			
<u>Wind Speed</u>	10 knots	11 knots			8 knots			
<u>Sea Height, ft</u>	2 ft	1 ft			2 ft			
<u>Weather</u>		overcast hazy cool			partly cloudy hazy cool			
<u>Secchi Disc</u>	5.5	1.5	2.3	4.2	6.5			
<u>Water Color</u>	slightly milky blue green	milky brownish green	slightly milky brownish green	slightly milky blue green	clear blue green			
<u>Surface Water Temperature, °C</u>	19.3°C	19.9°C	19.9°C	19.9°C	19.6°C	20.8°C	20.6°C	20.2°C
<u>Water Depth, ft</u>	74.5 ft	17.5 ft	29.0 ft	55.5 ft	134.5 ft	14.0 ft	27.5 ft	48.0 ft
<u>Bottom Type</u>	silty fine brown sand	silty medium brown sand	silty fine sand with few granules	silty fine brown sand	gelatinous soft gray gritless clay	silty coarse sand	silty fine brown sand	silty coarse and fine sand

Appendix A continued

<u>Station</u>	NDC-7-4	NDC-7-5	SDC-.25-1	SDC-.5-1	SDC-.5-2	SDC-.5-3	SDC-1-1	SDC-1-2
<u>Time, EST</u>	2350	0008	1710	0908	1718	1735	0855	1747

Wind Direction

Wind Speed

Sea Height, ft

Weather

Secchi Disc

Water Color

Surface Water Temperature, °C

Water Depth, ft

Bottom Type

3.8	1.7	3.5	3.2	1.7	4.0
milky brownish green	milky light green	milky brownish green	milky brownish green	milky light green	milky brownish green
20.8°C	19.9°C	20.8°C	21.0°C	19.8°C	21.0°C
49.5 ft	19.5 ft	28.5 ft	54.5 ft	13.5 ft	40.0 ft
silty fine brown sand	slightly silty coarse brown sand	silty fine brown gray sand	silty fine brown sand with gray sand inclusions	slightly silty fine brown sand	silty fine brown sand
silty medium sand	half inch tan clayey fine sand over gray clayey fine sand				

Appendix A continued

<u>Station</u>	SDC-1-3	SDC-2-1	SDC-2-2	SDC-2-3	SDC-2-4	SDC-4-1	SDC-4-2	SDC-4-3
<u>Time, EST</u>	1803	0835	1822	1836	1859	0815	1930	1949
<u>Wind Direction</u>				NW		NW	NW	
<u>Wind Speed</u>				7 knots		7 knots	4 knots	
<u>Sea Height, ft</u>				2 ft		1 ft		
<u>Weather</u>				overcast hazy		overcast hazy warm	overcast hazy	
<u>Secchi Disc</u>	3.0	1.6	3.8	3.5	6.0	2.0	too dark	too dark
<u>Water Color</u>	milky brownish green	milky light green	milky brownish green	milky brown green	clear blue green	milky light green	milky green	milky brownish green
<u>Surface Water Temperature, °C</u>	20.8°C	20.0°C	21.2°C	20.9°C	19.0°C	20.2°C	21.0°C	20.8°C
<u>Water Depth, ft</u>	61.5 ft	18.0 ft	27.5 ft	51.5 ft	72.5 ft	14.0 ft	37.5 ft	59.5 ft
<u>Bottom Type</u>	quarter inch tan silt over gray clayey fine sand	silty fine brown speckled sand	silty fine brown sand	silty brown fine sand with gray fine sand inclusions	half inch tan silty fine sand over gray fine silty sand	clean coarse brown speckled sand	silty fine brown sand	half inch tan clayey fine sand over gray clayey fine sand

Appendix A continued

Station SDC-4-4 SDC-7-1 SDC-7-2 SDC-7-3 SDC-7-4 SDC-7-5
Time, EST 2023 2139 2127 2112 2052

Wind Direction

Wind Speed

Sea Height, ft

Weather

Secchi Disc too dark too dark too dark
Water Color too dark too dark too dark

Surface Water Temperature, °C 19.6°C 21.5°C 21.4°C 21.0°C 20.8°C 19.8°C
Water Depth, ft 102.5 ft 14.0 ft 26.5 ft 51.5 ft 53.5 ft 70.5 ft

Bottom Type half inch silty silty silty silty silty
tan clayey fine fine fine fine fine
fine sand brown brown brown brown
over gray sand sand sand sand
clayey sand with
fine sand gray
sand fine
inclusions

Appendix B

PHYTOPLANKTON COLLECTIONS, 10 JULY 1970

Identification of Plate Components

Top line (left to right):

Station number, number of species or groups, total number of individuals per milliliter, and the diversity index of the collection.

Columns (left to right):

First Names of species or groups collected.

Second Numbers of individuals of each species or group, per milliliter.

Third Percentages of the total individuals that are represented by the individuals of each species or group. These are the N_i/N factors used in the diversity index equation.

Appendix B continued

NDC-7-1		46	1994	3.78	NDC-7-2		50	11523	1.09
CLOSTERIORPIS LONGISSIMA					TETRAEDRON OBESUM				
SCENEDESMUS BIJUGA	2			0.10	SYNEDRA ULMA V. CHAESANA			40	0.34
COELASTRUM SPHAERICUM	4			0.20	FRAGILARIA CAPUCINA			1	0.00
CHLAMYDOMONAS SP.	18			0.90	AMPHORA OVALIS			2	0.01
OOCYSTIS SP.	138			6.92	HALLOMONAS SP.			1	0.00
CYCLOTELLA SP.	10			0.50	GREEN CELLS			7	0.06
PERIDINIUM SP.	314			15.74	CRYPTOMONAS SP.			9974	86.55
TABELLARIA FENESTRATA	56			2.80	OOCYSTIS SOLITARIA			80	0.69
SCENEDESMUS ACHMINATUS	164			8.22	CYCLOTELLA MENECHINIANA			51	0.44
CHLAMYDOMONAS SP.	13			0.65	TABELLARIA FENESTRATA			249	2.16
CLOSTERIORPIS LONGISSIMA	2			0.10	CHLAMYDOMONAS SP.			209	1.81
SCENEDESMUS BIJUGA	18			0.90	DINOBRYON DIVERGENS			8	0.06
COELASTRUM SPHAERICUM	4			0.20	ANKISTRODESMUS FALCATUS			39	0.33
CRYPTOMONAS SP.	138			6.92	NITZSCHIA SP.			18	0.06
OOCYSTIS SP.	81			4.06	COELASTRUM SPHAERICUM			4	0.15
DINOFLLAGELLATE CYSTS	2			0.10	SCENEDESMUS QUADRICAUDA			6	0.03
FRAGILARIA INTERMEDIA	11			0.55	SCENEDESMUS OPOLIENSIS			2	0.05
MELOSIRA ISLANDICA	190			9.52	SCENEDESMUS DINORPHUS			4	0.01
MELOSIRA ITALICA	325			16.29	SCENEDESMUS ABUNDANS			2	0.03
DICTYOSPHAERIUM PULCHELLUM	54			2.70	QUADRIGULA CHODATII			2	0.01
FRAGILARIA CROTOMENSIS	29			1.45	PERIDINIUM SP.			37	0.32
ANKISTRODESMUS FALCATUS	14			0.70	GLENOLINIUM SP.			4	0.03
CLOSTERIUM SP.	1			0.05	FRANCEIA OVALIS			2	0.01
PEDIASTRUM DUPLEX	2			0.10	OSCILLATORIA SP.			1	0.00
NAVICULA SP.	3			0.15	NAVICULA SP.			6	0.05
AMPHORA SP.	4			0.20	COSMARIUM SP.			5	0.04
DINOBRYON DIVERGENS	20			1.00	DINOFLLAGELLATE CYSTS			8	0.06
TETRAEDRON LUNULA	2			0.10	AMBAEMA CIRCINALIS			24	0.20
TETRAEDRON PENTAEEDRICUM	1			0.05	CLOSTERIUM SP.			3	0.02
TETRAEDRON MINIMUM	4			0.20	KIRCHNERIELLA SP.			1	0.00
NITZSCHIA SP.	18			0.90	CERATIUM HIRUNDINELLA			2	0.01
SCENEDESMUS QUADRICAUDA	14			0.70	DICTYOSPHAERIUM PULCHELLUM			85	0.73
SCENEDESMUS ABUNDANS	9			0.45	OOCYSTIS BORGEI			25	0.21
SCENEDESMUS OPOLIENSIS	4			0.20	FRAGILARIA INTERMEDIA			17	0.14
COSMARIUM SP.	5			0.25	FRAGILARIA CROTOMENSIS			68	0.59
CHROOCOCCLUS SP.	2			0.10	CRUCIGENIA SP.			2	0.31
KIRCHNERIELLA SP.	1			0.05	MELOSIRA GRANULATA V. ANGUSTISSIMA			274	2.37
CPUCIGENIA QUADRATA	1			0.05	MELOSIRA ISLANDICA			152	1.31
AMBAEMA CIRCINALIS	5			0.25	SPORES			70	0.63
MOUGOTIA SP.	3			0.15	SCHROEDERIA JUDAYI			1	0.00
LAGERHEIMIA LONGISETA	2			0.10	NAVICULA GASTRUM			1	0.00
GREEN COLONY UNKNOWN	6			0.30	GLOEOCYSTIS SP.			6	0.05
SYNEDRA ULMA V. DANICA	1			0.05	TETRAEDRON MINIMUM			2	0.01
QUADRIGULA LACUSTRIS	1			0.05	TETRAEDRUS SMITHII			9	0.07
STAUSTRUM SP.	1			0.05	TETRAEDRUS WISCONSINENSIS			1	0.00
GREEN CELLS	295			14.79	TRIBONEMA SP.			1	0.31
					PEDIASTRUM DUPLEX			.1	0.00
					MOUGOTIA SP.			1	0.00
					MEPHROCYTIUM SP.			1	0.00
					SPORES RESTING			6	0.05

Appendix B continued

SDC-1-0	33	1396	3.81	SDC-1-1	27	830	3.33
COSMARIUM SP.				TABELLARIA FENESTRATA		226	27.22
TREUPARIA SETIGERUM		4	0.28	CYCLOTELLA SP.		180	21.68
DINOBRYON DIVERGENS		44	0.28	ANABAENA CIRCINALIS		44	5.30
TABELLARIA FENESTRATA		272	19.48	PERIDINIUM SP.		34	4.09
PERIDINIUM SP.		80	5.73	DINOBRYON DIVERGENS		52	6.26
ANKISTRODESMUS FALCATUS		12	0.85	CRYPTICOMNAS SP.		18	2.16
CYCLOTELLA SP.		162	11.60	CHLAMYDOMONAS SP.		40	4.81
STEPHANODISCUS SP.		162	11.60	MELOSTIRA SP.		8	0.96
OOCYSTIS SP.		48	3.43	ANKISTRODESMUS FALCATUS		4	0.48
CLOSTERIUM SP.		4	0.28	GOLEKINIA RADIATA		2	0.24
SCENEDESMUS ABUNDANS		8	0.57	OOCYSTIS SP.		18	2.16
SCENEDESMUS OPOLIENSIS		4	0.28	SYNEDRA ULNA		2	0.24
DICTYOSPHAERIUM PULCHELLUM		24	1.71	FRAGILARIA CROTOMENSIS		116	13.97
CRUCIGENIA QUADRATA		8	0.57	FRANCEIA DROESCHERI		2	0.24
MELOSTIRA SP.		226	16.18	FLAGELLATES		10	1.20
FRAGILARIA CROTOMENSIS		52	3.72	DIATOMA VULGARE		2	0.24
PEDIASTRUM DUPLEX		4	0.28	NAVICULA SP.		14	1.68
SYNEDRA ULNA		8	0.57	MALLOMONAS SP.		4	0.48
NAVICULA SP.		28	2.00	SCENEDESMUS SP.		6	0.72
ANABAENA CIRCINALIS		36	2.57	TREUBARIA SETIGERUM		2	0.24
AMPHORA SP.		12	0.85	AMPHORA SP.		4	0.48
STAUROCNEIS SP.		4	0.28	MOUGEOTIA SP.		2	0.24
NITZSCHIA SP.		16	1.14	MELOSTIRA GRANULATA V. ANGUSTISSIMA		18	2.16
CRYPTICOMNAS SP.		8	0.57	FRAGILARIA INTERMEDIA		8	0.96
SPORES		102	7.30	TETRAEDRON MINIMUM		2	0.24
DIATOMA VULGARE		4	0.28	NITZSCHIA SP.		10	1.20
FRAGILARIA CAPUCINA		12	0.85	SYNEDRA ULNA		2	0.24
TETRAEDRON MINIMUM		4	0.28				
AMPHORA OVALIS		4	0.28				
MELOSTIRA VARIANS		8	0.57				
SCENEDESMUS SP.		12	0.85				
MALLOMONAS SP.		12	0.85				
CHLAMYDOMONAS SP.		8	0.57				
				SDC-1-3	16	386	2.75
				TABELLARIA FENESTRATA		174	45.07
				CHLAMYDOMONAS SP.		6	1.55
				ANKISTRODESMUS FALCATUS		27	6.99
				OOCYSTIS SP.		12	3.10
				CYCLOTELLA SP.		12	3.10
				DINOBRYON DIVERGENS		16	4.14
				PERIDINIUM SP.		18	4.66
				ANABAENA SP.		26	6.73
				MOUGEOTIA SP.		4	1.03
				FRAGILARIA CROTOMENSIS		65	16.83
				DINOFAGELLATE CYSTS		8	2.07
				CRYPTICOMNAS SP.		2	0.51
				SYNEDRA SP.		2	0.51
				ASTERIONELLA FORMOSA		2	0.51
				SCENEDESMUS SP.		1	0.25
				MELOSTIRA GRANULATA		11	2.84
SDC-1-2	19	757	2.03				
FRANCEIA DROESCHERI							
HYPHODINIUM SP.		2	0.26				
TABELLARIA FENESTRATA		500	66.05				
PERIDINIUM SP.		74	9.77				
ANABAENA SP.		39	5.15				
DINOBRYON DIVERGENS		22	2.90				
CHLAMYDOMONAS SP.		20	2.64				
GLENODINIUM SP.		2	0.26				
ASTERIONELLA FORMOSA		16	2.11				
TETRAEDRON MINIMUM		1	0.13				
DINOFAGELLATE CYSTS		2	0.26				
OOCYSTIS SP.		3	0.39				
FRAGILARIA CROTOMENSIS		9	1.18				
COSMARIUM SP.		25	3.30				
FLAGELLATES		1	0.13				
GREENS UNKNOWN GRAPELIKE		22	2.90				
GREENS UNKNOWN CHAINS		4	0.52				
CYCLOTELLA SP.		10	1.32				
MOUGEOTIA SP.		4	0.52				
		1	0.13				

Appendix B continued

SDC-2-0	34	962	3-55	SDC-2-1	29	1012	3-58
ANKISTRODESMUS FALCATUS		6	0.62	SYNEDRA ULNA V. DANICA		2	0.19
CRYPTOMONAS SP.		11	1.14	SCENEDESMUS QUADRICAUDA V. MAXIMUS		7	0.69
CHLAMYDOMONAS SP.		19	1.97	ANKISTRODESMUS FALCATUS		4	0.39
TABELLARIA FENESTRATA		191	19.85	MICROCYSTIS AERUGINOSA		178	17.58
CYCLOTELLA SP.		252	26.19	CRYPTOMONAS SP.		19	1.87
ANABAENA CIRCINALIS		17	1.76	TABELLARIA FENESTRATA		191	18.87
PERIDINIUM SP.		43	4.46	CYCLOTELLA SP.		202	19.96
DINOBRYON DIVERGENS		41	4.26	ANABAENA CIRCINALIS		24	2.37
NITZSCHIA SP.		13	1.35	PERIDINIUM SP.		35	3.45
NAVICULA SP.		9	0.93	DINOBRYON DIVERGENS		48	4.74
FRAGILARIA CROTONENSIS		96	9.97	FRAGILARIA CROTONENSIS		106	10.47
SYNEDRA ULNA		11	1.14	COSMARIUM SP.		6	0.59
SPORES		13	1.35	MCUGECTIA SP.		9	0.88
GLUEOCYSTIS SP.		6	0.62	FRAGILARIA INTERMEDIA		13	1.28
MELOSIRA GRANULATA		37	3.84	FRAGILARIA CAPUCINA		13	1.28
MELOSIRA GRANULATA V. ANGUSTISSIMA		111	11.53	MELOSIRA GRANULATA		7	0.69
SYNEDRA ACUS		2	0.20	MELOSIRA GRANULATA V. ANGUSTISSIMA		19	1.87
SCENEDESMUS SP.		13	1.35	MELOSIRA ITALICA		13	1.28
TETRAEDRON MINIMUM		2	0.20	NEPHROCYTIUM SP.		11	1.08
MCUGECTIA SP.		4	0.41	NITZSCHIA SP.		24	2.37
FRAGILARIA INTERMEDIA		22	2.28	TETRAEDRON MINIMUM		9	0.88
UNCYSTIS SP.		6	0.62	AMPHORA SP.		4	0.39
GLENKINIA RADIATA		4	0.41	AMPHORA OVALIS		2	0.19
DINOFAGELLATE CYSTS		2	0.20	SCENEDESMUS OPOLIENSIS		4	0.39
NAVICULA GASTRUM		2	0.20	SCENEDESMUS SP.		7	0.69
DICTYOSPHAERIUM PULCHELLUM		2	0.20	UNCYSTIS SP.		45	4.44
PEDIASTRUM SP.		2	0.20	SCHROEDERIA JUDAYI		2	0.19
SUTIRELLA SP.		4	0.41	FRAGILARIA PINNATA		6	0.59
CALONEIS SP.		2	0.20	FRANCEIA OVALIS		2	0.19
DIPLONEIS SP.		2	0.20				
AMPHORA SP.		2	0.20				
CYMBELLA SP.		2	0.20				
FRANCEIA DROESCHERI		2	0.20				
FLAGELLATES		11	1.14				
				SDC-2-3	18	337	3.23
				TABELLARIA FENESTRATA		108	32.04
				CRYPTOMONAS SP.		5	1.48
				UNCYSTIS SP.		18	5.34
				ANABAENA CIRCINALIS		37	10.97
				DINOBRYON DIVERGENS		10	2.96
				CYCLOTELLA SP.		7	2.77
				CHLAMYDOMONAS SP.		16	4.74
				PERIDINIUM SP.		22	6.52
				DINOFAGELLATE CYSTS		1	0.29
				TETRAEDRON MINIMUM		2	0.59
				ASTERIONELLA FORMOSA		4	1.18
				ANKISTRODESMUS FALCATUS		8	2.37
				FRAGILARIA CAPUCINA		43	12.75
				CLOSTERIUM SP.		3	0.99
				FRAGILARIA INTERMEDIA		12	3.56
				FRAGILARIA CROTONENSIS		38	11.27
				OSCILLATORIA SP.		1	0.29
				SCENEDESMUS QUADRICAUDA		2	0.59
SDC-2-2	13	265	2.55				
TABELLARIA FENESTRATA		114	43.01				
UNCYSTIS SP.		11	4.15				
PERIDINIUM SP.		54	20.37				
ANKISTRODESMUS FALCATUS		12	4.52				
CRYPTOMONAS SP.		6	2.26				
DINOBRYON DIVERGENS		21	7.92				
CYCLOTELLA SP.		2	0.75				
FRAGILARIA CROTONENSIS		27	10.18				
ANABAENA SP.		12	4.52				
COSMARIUM SP.		2	0.75				
MCUGECTIA SP.		2	0.75				
TETRAEDRON MINIMUM		1	0.37				
CLOSTERIUM SP.		1	0.37				

Appendix B continued

SDC-2-4

12	316	2-29
DINOBYON DIVERGENS	63	19.93
OOCYSTIS SP.	7	2.21
TABELLARIA FENESTRATA	83	26.26
ANABAENA CIRCINALIS	5	1.58
PERIDINIUM SP.	15	4.74
FRAGILARIA CROTOMENSIS	122	38.60
ASTERIONELLA FORMOSA	3	0.94
COSMARIUM SP.	1	0.31
SCENEDESMUS SP.	1	0.31
FRAGILARIA CAPUCINA	14	4.43
FRANCEIA DROESCHERI	1	0.31
CYCLOTELLA SP.	1	0.31

SDC-4-1

31	567	3-56
PERIDINIUM SP.	51	8.99
TABELLARIA FENESTRATA	176	31.04
OOCYSTIS SP.	8	1.41
DINOBYON DIVERGENS	38	6.70
CYCLOTELLA SP.	58	10.22
DICTYOSPHAERIUM PULCHELLUM	2	0.35
FRANCEIA DROESCHERI	2	0.35
FRAGILARIA CROTOMENSIS	59	10.40
TETRAEDRON MINIMUM	6	1.05
ANABAENA CIRCINALIS	34	5.99
MOUGEOTIA SP.	1	0.17
MELOSIRA SP.	4	0.70
ACHNANTHES HAUCKIANA	2	0.35
SYNECRA ULNA V. CHAESANA	1	0.17
NAVICULA SP.	16	2.82
TRIBONEMA SP.	1	0.17
SCENEDESMUS SP.	11	1.94
FRAGILARIA INTERMEDIA	20	3.52
CLOSTERIUM SP.	1	0.17
MALLOMONAS SP.	3	0.52
CRYPTOCOMNAS SP.	18	3.17
FLAGELLATES	27	4.76
GLENKINIA RADIATA	2	0.35
MELOSIRA GRANULATA V. ANGUSTISSIMA	3	0.52
AMPHORA SP.	2	0.35
ANKISTRODESMUS FALCATUS	3	0.52
COSMARIUM SP.	2	0.35
NITZSCHIA SP.	8	1.41
SUTIRELLA SP.	2	0.35
CYMBELLA SP.	2	0.35
ZOOPORES	4	0.70

SDC-4-0

40	1104	4-22
CALONEIS VENTRICOSA V. TRUNCATA	2	0.18
COELASTRUM SP.	4	0.36
GLOEOCYSTIS SP.	4	0.36
COSMARIUM SP.	4	0.36
CLOSTERIUM SP.	2	0.18
NITZSCHIA ACICULARIS	10	0.90
CYMATOPLEURA SOLEA	4	0.36
NITZSCHIA SP.	24	2.17
NAVICULA SP.	30	2.71
NAVICULA GASTRUM	2	0.18
FRAGILARIA CROTOMENSIS	84	7.60
FRAGILARIA INTERMEDIA	34	3.07
FRAGILARIA CAPUCINA	62	5.61
ASTERIONELLA FORMOSA	4	0.36
PERIDINIUM SP.	104	9.42
CYCLOTELLA SP.	111	10.05
STEPHANODISCUS SP.	111	10.05
TABELLARIA FENESTRATA	148	13.40
ANABAENA CIRCINALIS	56	5.07
OOCYSTIS SOLITARIA	50	4.52
OOCYSTIS SUBMARINA	14	1.26
FRANCEIA DROESCHERI	12	1.08
ANKISTRODESMUS FALCATUS	16	1.44
DINOBYON DIVERGENS	70	6.34
MELOSIRA SP.	64	5.79
CRYPTOCOMNAS SP.	16	1.44
AMPHORA SP.	6	0.54
KIRCHNERIELLA SP.	2	0.18
TETRAEDRON MINIMUM	4	0.36
SCENEDESMUS DIMORPHUS	4	0.36
SCENEDESMUS SP.	18	1.63
DICTYOSPHAERIUM PULCHELLUM	2	0.18
MALLOMONAS SP.	4	0.36
CHROOCOCCLUS SP.	2	0.18
AMPHORA OVALIS	2	0.18
GLENKINIA RADIATA	4	0.36
NEPHROCITYIUM SP.	2	0.18
SYNECRA ULNA V. CHAESANA	4	0.36
NAVICULA CAPITATA	2	0.18
SCENEDESMUS QUADRICAUCA	6	0.54

Appendix B continued

SDC-7-2	42	13274	0.49	SDC-7-3	37	630	3.54
FRANCEIA DROESCHERI		1	0.00	TABELLARIA FENESTRATA		209	33.17
SCENEDESMUS QUADRICAUDA V. MAXIMUS		1	0.00	CHLAMYDOMONAS SP.		58	9.20
CLCSTERIUM SP.		2	0.01	CRYPTOMONAS SP.		25	3.96
GREEN CELLS LITTLE		12583	94.79	PERIDIUM SP.		22	3.49
OOCYSTIS SOLITARIA		17	0.12	GLENDINIUM SP.		16	2.53
OOCYSTIS BORGEI		7	0.05	STAUROCNIS SP.		1	0.15
TABELLARIA FENESTRATA		209	1.57	DINOBYRON DIVERGENS		13	2.06
ANABAENA CIRCINALIS		91	0.68	AMPHORA OVALIS		86	13.65
DINOBYRON DIVERGENS		75	0.56	CHLORELLA SP.		29	4.60
PERIDIUM SP.		34	0.25	SCENEDESMUS QUADRICAUDA		4	0.63
GLENDINIUM SP.		6	0.04	ASTERIONELLA FORMOSA		4	0.63
CHLAMYDOMONAS SP.		10	0.07	FRAGILARIA CROTONENSIS		64	10.15
CHLORELLA SP.		15	0.11	MELOSIRA ISLANDICA		8	1.26
CYCLUTELLA SP.		34	0.25	OOCYSTIS BORGEI		9	1.42
STEPHANODISCUS SP.		13	0.09	CYCLOTELLA SP.		19	3.01
MCUGECTIA SP.		3	0.02	STEPHANODISCUS SP.		05	0.79
ASTERIONELLA FORMOSA		6	0.04	MALLONAS SP.		3	0.47
MALLONAS SP.		3	0.02	NAVICULA SP.		2	0.31
FRAGILARIA CAPUCINA		13	0.09	NITZSCHIA SP.		8	1.26
CRYPTOMONAS SP.		54	0.40	TETRAEDRON MINIMUM		3	0.47
MELOSIRA ISLANDICA		6	0.04	ANKISTRODESMUS FALCATUS		6	0.95
MELOSIRA ITALICA		28	0.21	OOCYSTIS SOLITARIA		4	0.63
AMPHORA OVALIS		11	0.08	MCUGECTIA SP.		3	0.47
NAVICULA SP.		2	0.01	AMPHIPLEURA PELLUCIDA		1	0.15
SYNEDRA FILIFORMIS		9	0.06	CCSMARIUM SP.		4	0.63
ANKISTRODESMUS FALCATUS		3	0.02	COELASTRUM SPHAERICUM		1	0.15
TETRAEDRON MINIMUM		5	0.03	GLOEOCYSTIS SP.		1	0.15
SCENEDESMUS ARMATUS		6	0.04	FRAGILARIA CAPUCINA		7	1.11
CACTYLOCCOCCOPSIS SP.		1	0.00	FRANCEIA OVALIS		1	0.15
PHORMIDIUM SP.		1	0.00	SCENEDESMUS OPOLIENSIS		1	0.15
DIPLONEIS SP.		2	0.01	CYMATOPLEURA SOLFA		1	0.15
DIPLONEIS SP.		4	0.03	CERATIUM HIRUNDINELLA		1	0.15
SYNEDRA ULVA V. CHAESANA		2	0.01	SYNEDRA ULNA		1	0.15
TRIBONEMA SP.		1	0.00	SYNEDRA FILIFORMIS		1	0.15
SCENEDESMUS DIMORPHUS		1	0.00	FRAGILARIA INTERMEDIA		1	0.15
FRAGILARIA INTERMEDIA		1	0.00	SPORES RESTING		6	0.95
FRANCEIA OVALIS		5	0.03	DINOFLAGELLATE CYSTS		2	0.31
NEIDIUM DUBIUM		2	0.01			1	0.15
PEDIASTRUM DUPLEX		1	0.00				
ACHNANTHES SP.		2	0.01				
DICTYOSPHAERIUM PULCHELLUM		2	0.01				

Appendix B continued

SDC-7-4	26	712	3-20	DC-1	23	390	3-10
CHLAMYDOMONAS SP.		160	22.47	TABELLARIA FENESTRATA		126	32.30
CRYPTOMONAS SP.		40	5.61	PERIDINIUM SP.		65	16.66
CHLORELLA SP.		79	11.09	ANABAENA CIRCINALIS		38	9.74
ANABAENA CIRCINALIS		105	14.74	CYCLOTELLA SP.		20	5.12
TABELLARIA FENESTRATA		179	25.14	CHLAMYDOMONAS SP.		38	9.74
GLENODINIUM SP.		10	1.40	CRYPTOMONAS SP.		5	1.28
PERIDINIUM SP.		29	4.07	MOUGEOTIA SP.		7	1.79
CYCLOTELLA SP.		10	1.40	COSMARIUM SP.		3	0.76
STEPHANODISCUS SP.		10	1.40	ANKISTRODESMUS FALCATUS		4	1.02
CLUSTERIUM SP.		2	0.28	TETRAEDRON MINIMUM		3	0.76
MELOSIRA ISLANDICA		8	1.12	FRAGILARIA CROTONENSIS		27	6.92
FRAGILARIA CAPUCINA		33	4.63	COCYSTIS SP.		28	7.17
MALLOMONAS SP.		4	0.56	MELOSTRA SP.		4	1.02
GLUEOCYSTIS SP.		1	0.14	FRAGILARIA CAPUCINA		10	2.56
TETRAEDRON MINIMUM		6	0.84	NAVICULA SP.		2	0.51
ANKISTRODESMUS FALCATUS		6	0.84	SCENEDESMUS SP.		1	0.25
COSMARIUM SP.		2	0.28	DICTYOSPHAERIUM PULCHELLUM		1	0.25
DOCYSTIS SOLITARIA		12	1.68	PHORMIDIUM SP.		1	0.25
DOCYSTIS BURGEEI		5	0.70	GLENKINIA RADIATA		3	0.76
DINCFLAGELLATE CYSTS		3	0.42	FRANCEIA DROESCHERI		1	0.25
NITZSCHIA SP.		1	0.14	MALLOMONAS SP.		1	0.25
DIATOMA VULGARE		1	0.14	NITZSCHIA SP.		1	0.25
GREEN CELLS		2	0.28	AMPHOFA SP.		1	0.25
QUADRIGULA LACUSTRIS		1	0.14				
COELASTRUM SPHAERICUM		1	0.14				
ASTERIONELLA FORMOSA		2	0.28				
SDC-7-5	23	413	2-88	DC-2	24	47	3-63
PERIDINIUM SP.		23	5.56	TETRAEDRON LUNULA		2	0.49
GLENODINIUM SP.		3	0.72	TETRAEDRON MINIMUM		10	2.45
CRYPTOMONAS SP.		10	2.42	ANABAENA CIRCINALIS		39	9.58
CYCLOTELLA SP.		18	4.35	TABELLARIA FENESTRATA		104	25.55
CHLAMYDOMONAS SP.		1	0.24	PERIDINIUM SP.		49	12.03
GLUEOCYSTIS SP.		1	0.24	DOCYSTIS SOLITARIA		18	4.42
DOCYSTIS SOLITARIA		18	4.35	DINOBRYON DIVERGENS		38	9.33
ANABAENA CIRCINALIS		14	3.38	FRAGILARIA CROTONENSIS		21	5.15
DINOBRYON DIVERGENS		43	10.41	CRYPTOMONAS SP.		5	1.22
CLUSTERIUM SP.		1	0.24	CHLAMYDOMONAS SP.		22	5.47
AMPHOFA OVALIS		1	0.24	GREEN CELLS		43	10.56
CYNATOPLEURA SOLEA		1	0.24	FRANCEIA DROESCHERI		4	0.98
SCENEDESMUS OBLIQUENSIS		1	0.24	CYCLOTELLA SP.		7	1.71
ANKISTRODESMUS FALCATUS		1	0.24	ANKISTRODESMUS FALCATUS		7	1.71
MALLOMONAS SP.		2	0.48	MELOSTRA ISLANDICA		5	1.22
SYNEDRA SP.		6	1.45	MALLOMONAS SP.		5	1.22
DINOFAGELLATE CYSTS		3	0.72	DOCYSTIS SUBMARINA		4	0.98
FRAGILARIA CAPUCINA		5	1.21	COSMARIUM SP.		6	1.47
CHLORELLA SP.		18	4.35	MOUGEOTIA SP.		3	0.73
TABELLARIA FENESTRATA		44	10.65	ZOOPORES		6	1.47
SYNEDRA ULNA		192	46.48	SCENEDESMUS ABUNCANS		1	0.24
MELOSIRA ISLANDICA		1	0.24	TRIBONEMA SP.		1	0.24
SCENEDESMUS QUADRICAUC		4	0.96	ASTERIONELLA FORMOSA		4	0.98
		3	0.72	GLUEOCYSTIS SP.		3	0.73

Appendix B continued

DC-3	30	647	3.60	DC-5	12	286	2.88
GLENKINIA RADIATA				ANABAENA SP.			14.33
SCENEDESMUS OPOLTENSIS	1		0.15	TABELLARIA FENESTRATA		41	23.77
FRAGILARIA CROTONENSIS	1		0.15	ANKISTRODESMUS FALCATUS		68	2.79
TABELLARIA FENESTRATA	69		10.66	PERIDINIUM SP.	28	8	9.79
DINOBRYON DIVERGENS	106		28.74	DINOBRYON DIVERGENS	39	28	13.63
PERIDINIUM SP.	34		5.25	CYCLOTELLA SP.	2	2	0.69
CHLAMYDOMONAS SP.	61		9.42	OOCYSTIS SP.	17	17	5.94
CRYPTOMONAS SP.	38		5.87	FRAGILARIA CROTONENSIS	66	66	23.07
ANABAENA CIRCINALIS	11		1.70	COSMARIUM SP.	5	5	1.74
OOCYSTIS SOLITARIA	64		9.89	PEDIASTRUM DUPLEX	1	1	0.34
OOCYSTIS SP.	22		3.40	CHLAMYDOMONAS SP.	7	7	2.44
GLOEOCYSTIS SP.	3		0.46	ASTERIONELLA FORMOSA	4	4	1.34
ANKISTRODESMUS FALCATUS	2		0.30				
MALLONAS SP.	6		0.92	DC-6	11	333	2.39
CYCLOTELLA SP.	6		0.92	QUADRIGULA LACUSTRIS			0.60
ZOOSPORES	8		1.23	ANABAENA SP.	2	4	1.20
TETRAEDRON MINIMUM	3		0.46	CLOSTERIUM SP.	1	1	0.30
COSMARIUM SP.	17		2.62	DINOBRYON DIVERGENS	99	99	17.71
CRUCIGENIA QUADRATA	4		0.61	PERIDINIUM SP.	28	28	8.40
ASTERIONELLA FORMOSA	1		0.15	TABELLARIA FENESTRATA	88	88	26.42
GREEN CELLS TINY	7		1.08	OOCYSTIS SP.	32	32	9.60
GREEN CELLS	32		4.94	TETRAEDRON MINIMUM	3	3	0.90
TRIPORENA SP.	38		5.87	FRAGILARIA CROTONENSIS	112	112	33.63
CYMBELLA SP.	1		0.15	LAGERHEIMIA LONGISETA	2	2	0.60
FRAGILARIA INTERMEDIA	21		3.24	SCENEDESMUS SP.	2	2	0.60
SYNEDRA ULNA	1		0.15				
QUADRIGULA LACUSTRIS	1		0.15	NDC-25-1	26	458	3.39
MUGEOTIA SP.	6		0.92	TABELLARIA FENESTRATA			33.47
NITZSCHIA SP.	1		0.15	ANABAENA CIRCINALIS	153	36	7.86
SCENEDESMUS QUADRIGULICA	1		0.15	DINOBRYON DIVERGENS	32	32	6.98
	1		0.15	PERIDINIUM SP.	49	49	10.60
	1		0.15	OOCYSTIS SUBMARINA	4	4	0.97
	1		0.15	OOCYSTIS SUBMARINA	19	19	4.14
	1		0.15	ZOOSPORES	44	44	9.60
	1		0.15	MALLONAS SP.	6	6	1.31
	1		0.15	CRYPTOMONAS SP.	7	7	1.52
	1		0.15	CYCLOTELLA SP.	12	12	2.62
	1		0.15	COSMARIUM SP.	4	4	0.87
	1		0.15	TETRAEDRON MINIMUM	5	5	1.09
	1		0.15	NAVICULA SP.	2	2	0.43
	1		0.15	FRAGILARIA CROTONENSIS	37	37	8.07
	1		0.15	DINOBRYON DIVERGENS	1	1	0.21
	1		0.15	FRANCEIA DRIESCHERI	3	3	0.65
	1		0.15	CHLAMYDOMONAS SP.	21	21	4.58
	1		0.15	ANKISTRODESMUS FALCATUS	3	3	0.65
	1		0.15	ANKISTRODESMUS BRAUNII	3	3	0.65
	1		0.15	FRAGILARIA CAPUCINA	9	9	1.96
	1		0.15	NITZSCHIA SP.	2	2	0.43
	1		0.15	FLAGELLATES	2	2	0.43
	1		0.15	SYNEDRA ULNA	1	1	0.21
	1		0.15	FRAGILARIA INTERMEDIA	1	1	0.21
	1		0.15	BLUE-GREEN UNKNOWN COLONIES	1	1	0.21
	1		0.15	MUGEOTIA SP.	1	1	0.21

DC-4

DC-4	15	448	1.85
GREEN CELLS			62.72
ANKISTRODESMUS FALCATUS	281		2.00
TABELLARIA FENESTRATA	9		20.98
CRYPTOMONAS SP.	94		0.44
DINOBRYON DIVERGENS	2		1.56
CYCLOTELLA SP.	7		0.89
PERIDINIUM SP.	4		1.33
OOCYSTIS SP.	6		1.11
ANABAENA CIRCINALIS	5		2.23
NITZSCHIA SP.	10		0.66
FRAGILARIA CROTONENSIS	3		4.24
SCENEDESMUS SP.	19		0.66
TETRAEDRON MINIMUM	3		0.44
NAVICULA SP.	2		0.22
FRAGILARIA INTERMEDIA	1		0.44

Appendix B continued

NDC-5-0	42	1794	3.92	NDC-5-1	43	504	3.88
FRAGILARIA INTERMEDIA		15	0.83	CYCLOTELLA MENEHINIANA		58	11.50
ANABAENA CIRCINALIS		52	2.89	ZOOPORES		21	4.16
MOUGEETIA SP.		4	0.22	TABELLARIA FENESTRATA		146	28.96
TREUBARIA SETIGERUM		4	0.22	ANABAENA CIRCINALIS		24	4.76
LAGERHEIMIA SP.		4	0.22	OOCYSTIS SOLITARIA		15	2.97
FRANCEIA DROESCHERI		4	0.22	FLAGELLATES		4	0.79
CYCLOTELLA SP.		230	12.82	MELOSIRA GRANULATA		39	7.73
ZOOPORES		300	21.73	PERIDINIUM SP.		36	7.14
OOCYSTIS SOLITARIA		82	4.57	FRAGILARIA CROTONENSIS		38	7.53
OOCYSTIS SP.		15	0.83	DINOBRYON DIVERGENS		19	3.76
OOCYSTIS SUBMARINA		48	2.67	NITZSCHIA SP.		8	1.58
SCENEDESMUS QUADRICAUDA		7	0.39	NITZSCHIA ACICULARIS		6	1.19
SCENEDESMUS INCRASSATUS		4	0.22	MALLOPCNAS SP.		8	1.58
SCENEDESMUS OPOLTENSIS		7	0.39	NAVICULA COSTULATA		1	0.19
SCENEDESMUS SP.		15	0.83	NAVICULA DECUSIS		1	0.19
PERIDINIUM SP.		96	5.35	NAVICULA SP.		3	0.59
DICTYOSPHAERIUM PULCHELLUM		59	3.28	STEPHANODISCUS SP.		4	0.79
CRYPTOMONAS SP.		4	0.22	GOLENKINIA RADIATA		2	0.39
DINOFAGELLATE CYSTS		4	0.22	SYNEDRA ULNA V. DANICA		2	0.39
FRAGILARIA CROTONENSIS		100	5.57	SURIPELLA ANGUSTATA		4	0.79
DINOBRYON DIVERGENS		59	3.28	CRUCIGENIA QUADRATA		1	0.19
TABELLARIA FENESTRATA		170	9.47	ANKISTRODESMUS FALCATUS		2	0.39
QUADRIGULA LACUSTRIS		4	0.22	SYNEDRA VAUCHERIAE V. FRAGILARIOIDES		18	3.57
GREEN COLONY UNKNOWN		7	0.39	OOCYSTIS SP.		2	0.39
TETRAEDRON MINIMUM		4	0.22	CHLAMYDOMONAS SP.		5	0.99
MELOSIRA SP.		252	14.04	MOUGEETIA SP.		2	0.39
ACMANTHES SP.		4	0.22	DIATOMA VULGARE		1	0.19
NAVICULA SP.		22	1.22	COSMARTIUM SP.		3	0.59
APHORA SP.		18	1.00	SCENEDESMUS QUADRICAUCA		1	0.19
SPORES		4	0.22	TETRAEDRON MINIMUM		2	0.39
NEIDIUM DURTIUM		4	0.22	CRYPTOMONAS SP.		8	1.58
CRUCIGENIA QUADRATA		11	0.61	CYMATOPLURA SOLEA V. APICULATA		1	0.19
KIRCHNERIELLA SP.		4	0.22	NAVICULA TRIPUNCTATA		1	0.19
SURIPELLA SP.		4	0.22	LAGERHEIMIA LONGISSETA V. MAJOR		1	0.19
SYNEDRA SP.		11	0.61	DICTYOSPHAERIUM PULCHELLUM		1	0.19
GOLENKINIA RADIATA		11	0.61	SCENEDESMUS DIMORPHUS		1	0.19
NITZSCHIA SP.		7	0.39	FRANCEIA DROESCHERI		1	0.19
ANKISTRODESMUS FALCATUS		18	1.00	SURIPELLA SP.		1	0.19
SCENEDESMUS DIMORPHUS		7	0.39	ASTERIONELLA FORMOSA		4	0.79
CLOSTERIUM SP.		7	0.39	SC-HROEDERIA JUDAYI		1	0.19
MALLOPCNAS SP.		11	0.61	CALONEIS VENTRICOSA		1	0.19
CHLAMYDOMONAS SP.		11	0.61	APHORA SP.		1	0.19
				FRAGILARIA CONSTRUENS		6	1.19

Appendix B continued

NDC-5-2

	26	647	3-53
CYCLOTELLA SP.		8	1.23
ZOOPORES		32	4.94
ANABAENA CIRCINALIS		56	8.65
PERIDINIUM SP.		73	11.28
DINOBRYON DIVERGENS		56	8.65
OOCYSTIS SOLITARIA		47	7.26
TABELLARIA FENESTRATA		136	21.02
CHLAMYDOMONAS SP.		6	0.92
FRANCEIA DROESCHERI		2	0.30
FRAGILARIA CAPUCINA		69	10.66
FRAGILARIA CROTOMENSIS		96	14.83
PELIASTRUM DUPLEX		1	0.15
PELIASTRUM SIMPLEX		1	0.15
FRAGILARIA INTERMEDIA		1	0.30
ANKISTRUDESCHUS FALCATUS		10	1.54
CINCLAGELLATE CYSTS		2	0.30
TETRAEDRON MINIMUM		6	0.92
CRYPTOMONAS SP.		9	1.39
OOCYSTIS SP.		8	1.23
MELOSIRA SP.		5	0.77
GLOEUCYSTIS SP.		4	0.61
SPORES		12	1.85
NAVICULA SP.		3	0.46
SYNEDRA SP.		1	0.15
CLOSTERIUM SP.		1	0.15
SCENEDESCHUS QUADRICAUCIA		1	0.15

NDC-5-3

	17	528	2-89
TABELLARIA FENESTRATA		193	36.55
OOCYSTIS SOLITARIA		70	13.25
OOCYSTIS SP.		6	1.13
CHLAMYDOMONAS SP.		31	5.87
PERIDINIUM SP.		58	10.90
FRAGILARIA CROTOMENSIS		31	5.87
ANABAENA CIRCINALIS		55	10.41
DINOBRYON DIVERGENS		55	10.41
MOUGOTIA SP.		2	0.37
CGSMARIUM SP.		4	0.75
ANKISTRUDESCHUS FALCATUS		6	1.13
SCENEDESCHUS ARUNDANS		1	0.10
TETRAEDRON MINIMUM		6	1.13
CYCLOTELLA SP.		5	0.94
GLENKINIA RADIATA		1	0.10
CRYPTOMONAS SP.		2	0.37
SPORES RESTING		2	0.37

NDC-1-0

	36	3052	3-90
SYNECHA ULNA V. CHAESANA		8	0.26
SYNEDRA DELICATISSIMA V. ANGUSTISSIMA		24	0.78
SYNEDRA ACUS		20	0.65
AMPHORA SP.		8	0.26
GCMPHCNEMA SP.		4	0.13
FRAGILARIA BREVISTRATA		92	3.01
FRAGILARIA CROTOMENSIS		76	2.49
FRAGILARIA INTERMEDIA		40	1.31
SYNEDRA SP.		24	0.78
MELOSIPA SP.		572	18.74
MELUSIRA GRANULATA V. ANGUSTISSIMA		264	8.65
GLOEUCYSTIS SP.		36	1.17
FRANCEIA SP.		12	0.39
NAVICULA SP.		20	0.55
NITZSCHIA SP.		28	0.91
OOCYSTIS SP.		148	4.84
DICTYOSPHAERIUM PULCELLUM		32	1.04
CHLAMYDOMONAS SP.		8	0.26
SCENEDESCHUS SP.		32	1.04
TABELLARIA FENESTRATA		156	5.11
PERIDINIUM SP.		96	3.14
CYCLOTELLA MENECHINIANA		524	17.16
ANABAENA CIRCINALIS		64	2.09
DINOBRYON DIVERGENS		40	1.31
TETRAEDRON MINIMUM		8	0.26
SPORES		48	1.57
COELASTRUM SP.		4	0.13
ANKISTRUDESCHUS FALCATUS		8	0.24
CRYPTOMONAS SP.		60	1.96
UNKNOWN CELLS		436	14.78
BLUF-GREEN UNKNOWN COLONIES		12	0.39
KIRCHNERIELLA SP.		4	0.13
MELOSIRA VARIANS		20	0.65
FRAGILARIA CAPUCINA		116	3.80
CYMBELLA SP.		4	0.13
SCENEDESCHUS ABUNCANS		4	0.13

Appendix B continued

NCC-1-1				
	31	1244	3.88	
CRYPTOMYNAS SP.		28	2.25	
UNKNOWN CELLS		4	0.32	
TABELLARIA FENESTRATA		140	11.25	
PERIDINIUM SP.		64	5.14	
CYCLotella SP.		324	26.04	
ANABAENA CIRCINALIS		28	2.25	
OOCYSTIS SP.		32	2.57	
DINCBRYON DIVERGENS		68	5.46	
COSMARIUM SP.		8	0.64	
FUND CELLS BROKEN COLONIES		28	2.25	
MELOSIRA GRANULATA V. ANGUSTISSIMA		60	4.82	
TETRAEDRON MINIMUM		20	1.60	
SCENEDESMUS OPOLIENSIS		4	0.32	
SCENEDESMUS INCRASSTULUS		8	0.64	
SCENEDESMUS SP.		24	1.92	
NITZSCHIA SP.		28	2.25	
FRAGILARIA CROTONENSIS		108	8.68	
GLAUCOCYSTIS SP.		8	0.64	
NAVICULA SP.		12	0.96	
MELOSIRA GRANULATA		92	7.39	
CHLAMYDOMONAS SP.		12	0.96	
SPIRES		44	3.53	
DINIFLAGELLATE CYSTS		4	0.32	
STEPHANODISCUS SP.		4	0.32	
PEDIASTRUM DUPLEX		4	0.32	
GREEN COLONY UNKNOWN		4	0.32	
CLOSTERIUM SP.		4	0.32	
GOMPHONEMA SP.		4	0.32	
FRAGILARIA CAPUCINA		64	5.14	
SCENEDESMUS ABUNDANS		4	0.32	
SCENEDESMUS QUADRICAUDA		8	0.64	
NCC-1-2				
	21	974	1.65	
TABELLARIA FENESTRATA		141	14.47	
BLUE-GREEN UNKNOWN COLONIES		689	70.73	
DINCBRYON DIVERGENS		10	1.02	
PERIDINIUM SP.		44	4.51	
ANABAENA CIRCINALIS		17	1.74	
CHLAMYDOMONAS SP.		6	0.61	
OOCYSTIS SOLITARIA		11	1.12	
FRAGILARIA CROTONENSIS		15	1.54	
CRYPTOMYNAS SP.		6	0.61	
SCENEDESMUS BIJUGA		1	0.10	
GLAUCOCYSTIS SP.		1	0.10	
FRAGILARIA CAPUCINA		16	1.64	
SCENEDESMUS OPOLIENSIS		1	0.10	
OOCYSTIS SP.		4	0.41	
FRANCEJA OVALIS		3	0.30	
CALONEIS SP.		1	0.10	
SYNEDRA ULNA		1	0.10	
MALLCOMNAS SP.		1	0.10	
TETRAEDRON MINIMUM		1	0.10	
CYCLotella SP.		5	0.51	
NDC-1-3				
	25	543	3.28	
TABELLARIA FENESTRATA		114	20.99	
PERIDINIUM SP.		58	10.68	
OOCYSTIS SP.		70	12.89	
ANABAENA CIRCINALIS		110	20.25	
DINCBRYON DIVERGENS		63	11.60	
CHLAMYDOMONAS SP.		18	3.31	
GLAUCOCYSTIS SP.		2	0.36	
MALLCOMNAS SP.		3	0.55	
SYNEDRA ULNA V. DANICA		2	0.36	
FRAGILARIA CROTONENSIS		49	9.02	
SPORES		10	1.84	
GLENNKINIA RADIATA		1	0.18	
COSMARIUM SP.		8	1.47	
DICTYOSPHAERIUM PULCHELLUM		1	0.18	
TETRAEDRON MINIMUM		5	0.92	
FRAGILARIA CAPUCINA		6	1.10	
SCENEDESMUS SP.		2	0.36	
MCUGEOITIA SP.		4	0.73	
FRANCEJA DROESCHERI		2	0.36	
GREENCELLS ROUND UNKNOWN		5	0.92	
QUADRIGULA LACUSTRIS		1	0.18	
ANKISTRODESMUS FALCATUS		1	0.18	
CRYPTOMYNAS SP.		5	0.92	
NITZSCHIA SP.		1	0.18	
CYCLotella SP.		2	0.36	

Appendix B continued

NDC-2-0		36	1180	4.27	NDC-2-1		43	940	4.05
CRUCICENTA QUADRATA			12	1.01	SYNEDRA ULNA V. DANICA			5	0.53
ANKISTRODESMUS FALCATUS			12	1.01	KIRCHNERIELLA SP.			1	0.10
CYCLOTELLA SP.			172	14.57	GCMPHONEMA SP.			2	0.21
CHLAMYDOMONAS SP.			84	7.11	AMPHORA OVALIS			4	0.42
TARELLARIA FENESTRATA			120	10.16	CYCLOTELLA SP.			88	9.36
OOCYSTIS SP.			80	6.77	STEPHANIDISCUS SP.			88	9.36
PERIDIUM SP.			64	5.42	TARELLARIA FENESTRATA			228	24.25
DINOBRYON DIVERGENS			24	2.03	DINOBRYON DIVERGENS			54	5.74
ANABAENA CIRCINALIS			36	3.05	PERIDIUM SP.			57	6.06
PLECTASTRUM DUPLEX			4	0.33	ANABAENA CIRCINALIS			32	3.40
CRYPTOMONAS SP.			24	2.03	OOCYSTIS SOLITARIA			25	2.65
SYNEDRA SP.			20	1.69	CHLAMYDOMONAS SP.			18	1.91
SCENEDESMUS SP.			20	1.69	GREEN CELLS			23	2.44
FRAGILARIA CROTONENSIS			64	5.42	CRYPTOMONAS SP.			87	9.25
SPORES			28	2.37	FRAGILARIA CROTONENSIS			17	1.80
DICTYOSPHAERIUM PULCHELLUM			36	3.05	FRAGILARIA INTERMEDIA			23	2.44
GLUEOCYSTIS SP.			20	1.59	FRAGILARIA CAPUCINA			2	0.21
MELOSIRA GRANULATA			56	4.74	FRAGILARIA PINNATA			3	0.31
COELASTRUM SP.			8	0.67	FRANCEIA DROESCHERI			2	0.31
HALLOMONAS SP.			4	0.33	SCENEDESMUS SP.			2	0.21
MCUGECTIA SP.			8	0.67	SCENEDESMUS QUADRICAUCA			29	3.04
FRAGILARIA PINNATA			12	1.01	MELOSIRA ITALICA			7	0.74
KIRCHNERIELLA SP.			8	0.67	WELCSIRA ISLANDICA			16	1.70
QUADRIGULA SP.			4	0.33	NAVICULA SP.			30	3.19
FRANCEIA OVALIS			8	0.67	NITZSCHIA SP.			12	1.27
MELOSIRA GRANULATA V. ANGUSTISSIMA			168	14.23	ZOOPORES			5	0.53
CCSMARIUM SP.			12	1.01	CCSMARIUM SP.			6	0.63
NAVICULA SP.			8	0.67	OOCYSTIS SURMARINA			3	0.31
SCENEDESMUS ABUNDANS			4	0.33	ANKISTRODESMUS FALCATUS			1	0.10
SCENEDESMUS DIMORPHUS			4	0.33	NEIDILM DURIUM			5	0.53
TETRAEDRON MINIMUM			4	0.33	TETRAEDRON MINIMUM			6	0.53
FRAGILARIA INTERMEDIA			20	1.69	GLUEOCYSTIS SP.			1	0.10
CLOSTERIOPSIS LONGISSIMA			4	0.33	CERATIUM HIRUNDINELLA			1	0.10
BLUE-GREEN UNKNOWN COLONIES			16	1.35	SURIRELLA SP.			2	0.21
					TRIACNEMA SP.			1	0.10
					CYMATOPLEURA SOLEA			1	0.10
					DINGFLAGELLATE CYSTS			1	0.10
					COELASTRUM SP.			1	0.10
					SCENEDESMUS ABUNDANS			2	0.21
					LAGERHEIMIA SP.			1	0.10
					SCENEDESMUS OPOLIENSIS			2	0.21
					SCHROEDERIA JUDAYI			20	2.12

Appendix B continued

NDC-2-2

	21	504	3.85
TABELLARIA FENESTRATA		88	17.46
CHLAMYDOMONAS SP.		40	7.93
OOCYSTIS SP.		44	8.73
PERIDINIUM SP.		52	10.31
DINCBRYON DIVERGENS		60	11.90
ANABAENA CIRCINALIS		24	4.76
NAVICULA SP.		28	5.55
STEPHANODISCUS SP.		4	0.79
CHELOSphaerium SP.		20	3.96
SPORES		12	2.38
CUSMARIUM SP.		8	1.58
GLOEOCYSTIS SP.		4	0.79
NITZSCHIA SP.		8	1.58
MELUSIPA ISLANDICA		8	1.58
CYCLotella SP.		36	7.14
FLAGELLATES		16	3.17
FRAGILARIA CAPUCINA		28	5.55
MELUSIPA GRANULATA		8	1.58
TETRAEDRON MINIMUM		4	0.79
HALLUPPIAS SP.		4	0.79
FRAGILARIA CROTCHENSIS		8	1.58

NDC-2-4

	20	515	2.91
CCELOSphaerium SP.		2	0.38
DINOFLLAGELLATE CYSTS		2	0.38
TABELLARIA FENESTRATA		143	27.76
ANABAENA CIRCINALIS		9	1.74
PERIDINIUM SP.		19	3.68
OOCYSTIS SOLITARIA		63	12.23
DINCBRYON DIVERGENS		39	7.57
CHLAMYDOMONAS SP.		46	8.93
FRAGILARIA CROTCHENSIS		146	28.34
OOCYSTIS SP.		4	0.77
CYCLotella SP.		4	0.77
SCENEDESMUS QUADRICAUDA		2	0.38
SPORES		13	2.52
GLOEOCYSTIS SP.		2	0.38
CUSMARIUM SP.		4	0.77
PEDIASTRUM SP.		2	0.38
SCENEDESMUS SP.		2	0.38
CRYPTOMONAS SP.		9	1.74
MCUGEDIA SP.		2	0.38
MALLCOMONAS SP.		2	0.38

NDC-2-3

	21	601	3.46
CHLAMYDOMONAS SP.		58	9.65
DINCBRYON DIVERGENS		58	9.65
OOCYSTIS SOLITARIA		96	15.97
OOCYSTIS SP.		7	1.16
PERIDINIUM SP.		39	6.48
ANABAENA CIRCINALIS		32	5.32
TABELLARIA FENESTRATA		132	21.96
DICTYOSphaerium PULCHELLUM		2	0.33
FRAGILARIA CROTCHENSIS		70	11.64
MCUGEDIA SP.		4	0.66
ASTERIONELLA FORMOSA		13	2.16
CRYPTOMONAS SP.		17	2.82
TETRAEDRON MINIMUM		11	1.83
SPORES		7	1.16
GREEN CELLS LITTLE		37	6.15
SYNEDRA ULNA V. DANICA		4	0.66
CYCLotella SP.		4	0.66
SCENEDESMUS SP.		2	0.33
QUADRIGULA LACUSTRIS		2	0.33
NAVICULA SP.		2	0.33
MELOSIRA SP.		4	0.66